SOVIET CYBERNETICS:

Recent News Items

Vol. 3 No. 3

Edited by
Dorothy McDonald and Wade B. Holland

March 1969

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In this issue . . .

Articles marked with an asterisk (*) conclude with a brief analysis prepared by the *SC:RNI* staff.

BRIEF ITEMS...

GLUSHKOV CITES IBM PURCHASE OF MIR-1 COMPUTER. Viktor M. Glushkov, developer of the Mir-1 small computer, and one of the Soviet Union's leading cyberneticists, has repeated the Soviet claim, first made last October, that a Mir computer has been sold to International Business Machines. The earlier report, together with IBM's strong denial, was published in *SC:RNI/68/23*, pp. 3, 44. Glushkov's article is translated in full in this issue, pp. 5-10.

60,000-RUBLE PRICE TAG ON MIR. The Mir computer has been cited as costing "up to 60,000 rubles," an example of a "simple and comparatively inexpensive machine." (From the book *Primenenie elektronnykh vychislitel'nykh mashin v stroitel'noj mekhanike*, Naukova dumka, Kiev, 1968, p. 6 [File No. 02244B].)

BESM-3M AT LENINGRAD STAT UNIVERSITY. A small photograph of the Computer Center at Leningrad State University appears in *Nedelya*, No. 6, Feb. 9, 1969, p. 11. The computer shown in this photograph, although not identified in the caption, is a BESM-3M. Information on this machine, including a photograph, can be found in *SC:RNI/67/6*, pp. 12-14 (File No. 02277R).

COMPUTERS USED FOR MISSILE TRAJECTORY CALCULATIONS. Computers are used in three phases of rocket and missile development and flight in the Soviet Union. General-purpose machines, operating in the 5,000-20,000 opns/sec range, are of the type used in solving scientific and engineering design problems; typical machines include the M-20, M-220, BESM-2, Kiev, Strela, Ural-2, Ural-4, Minsk-2, Razdan-2, etc. Special-purpose computers, in some cases capable of 100,000 opns/sec or higher, are used to process data related to missile testing problems and in combat tasks related to missile

applications. Special-purpose computers for solving combat-type problems can be installed either on the ground or on-board the rocket.

(From the book *Dvizhenie raket*, by A. A. Dmitrievskij, *et al.*, Voennoe izdatel'stvo, Moscow, 1968, pp. 152-153 [File No. 02291B].)

ELLIOTT-503 USED FOR ECONOMICS MODELING. An Elliott-503 computer at the Main Computer Center of GOSPLAN, USSR, has been used for modeling the effective consumer demand of the Soviet population during the period 1968-70. The work was done by the USSR Ministry of Trade's All-Union Scientific Research Institute of Municipal Sanitation, and was programmed by M. R. Borimechkov. It was reported at a conference held at the Central Economic Statistics Institute in 1966. Results of the modeling indicated that demand for products other than foodstuffs will increase more rapidly than for foodstuffs. Various significant qualitative shifts in effective demand were also predicted.

(From the article "K voprosu o metodologii prognozirovaniya struktury platezhesposobnogo sproca," by V. M. Bredov and A. I. Levin, in the book *Opyt primeneniya matematicheskikh metodov i EVM v ekonomiko-matematicheskom modelirovanii potrebleniya*, Nauka, Moscow, 1968, p. 124 [File No. 02242B].)

GOSPLAN USES ALGOL-60 ON ELLIOTT-503 COMPUTER. GOSPLAN of the USSR has equipped its Elliott-503 computer with ALGOL-60, and used it to solve a problem of optimal planning for the development, distribution, and specialization of enterprises of an arbitrary multi-product industrial branch.

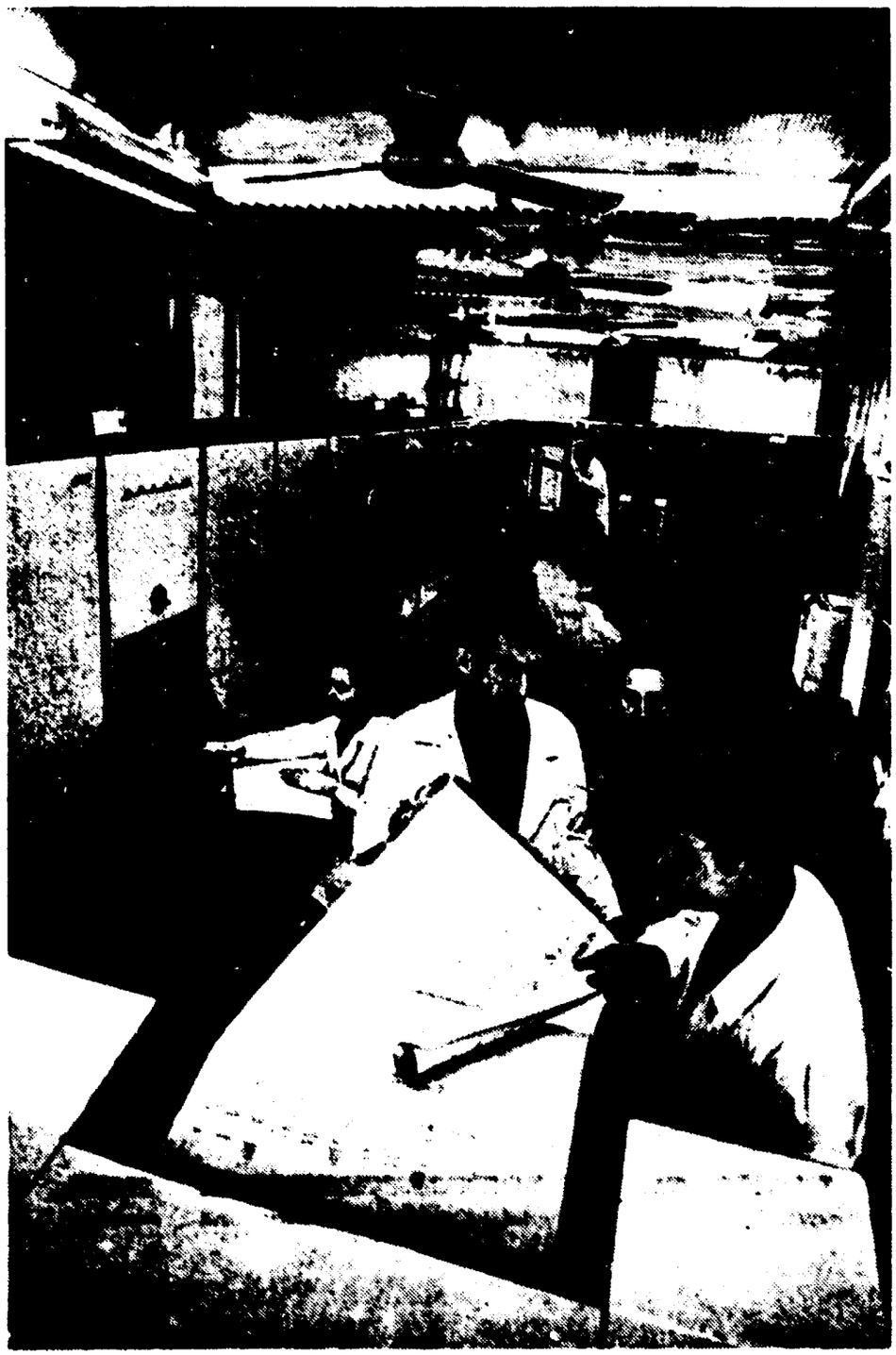
(From the article "Metod, algoritm, i programma resheniya setevoj zadachi razmeshcheniya predpriyatij mnogoproduktovoj otrasli," by Yu. I. Solodilov, in the book *Primenenie matematicheskikh metodov v razmeshchenii proizvodstva*, Nauka, Moscow, 1968, pp. 209-243 [File No. 02241B].)

MODEL OF IDEOLOGICAL WARFARE. A recently published Soviet book contains a description of a model of ideological warfare in human society in a chapter on game theory and sociology. The book is entitled *Optimality Problems in Theoretical Cybernetics*, by L. N. Volgin; it was published in 1968 by Sovetskoe Radio Publishing House. Aspects of the general problem of optimality are considered from a cybernetic viewpoint. Much of the book, according to the abstract appearing in the *Journal of Abstracts--Cybernetics*, is concerned with mathematical problems and methods of optimal planning. Several chapters are devoted to game theory, considering the fundamentals of game theory, game theory and economics, and game theory and sociology. The abstract indicates that the latter chapter covers "the influence of social laws on the behavior of individuals and a 'model of ideological warfare' in human society." Since the book has not yet become available in the United States, it is not clear whether it describes work undertaken in the Soviet Union, or is based on a survey of U.S. literature.

(From the abstract in *Referativnyj zhurnal--kibernetika*, No. 11, 1968, Part G, No. 408, of the book *Problema optimal'nosti v teoreticheskoj kibernetike* [File No. 02243R].)

NEW COMPUTER CENTER IN KIRGHIZ SSR. A new computer center has been put into operation in the Kirghiz SSR. The center, which is equipped with Minsk-22 computers, will process all the initial data from enterprises, organizations, and construction sites. Plans have been made to establish district computer centers in large cities, using as a basis the existing mechanized accounting stations. They will be united into a single republic network of computer centers.

(From the article "Vychislitel'nyj tsentr," in the newspaper *Izvestiya*, February 13, 1969, p. 1 [File No. 02281N].)



The Computing and Information Center at the Frezer Plant, showing what is believed to be its Ural-11 computer
Source: Pravda, Feb. 25, 1969, P. 1 (File No. 02264P)

o Glushkov Claims Mir Sale to IBM

o New Model Under Development

Small Computers Take the Lead

Academician V. Glushkov,
Laureate of Lenin and
State Prizes

The use of computers in production and scientific research has become an objective necessity due to the requirements of the scientific-technical revolution. Almost any branch of the "scientific tree" today is successfully developing and reaping fruit only with the active and efficient application of computers. The majority of engineering calculations now are simply unthinkable without computer application.

At the same time, the powerful computers available in the Soviet Union are generally intended for the solution of large-scale scientific and engineering problems. They are located in computer centers and cannot be easily mastered by ordinary scientific workers or engineers. The turn-around time for submitting problems to a center's computer is rather long. Even if the program is expressed in an algorithmic language, it must still go through several stages of processing--punching on data media (punchcards or papertape), translation stage (translation into machine language), debugging of control calculations, and, finally, the actual process of computation. All of these operations take time. Even the comparatively low-speed M-220 computer, which executes 20,000-30,000 opns/sec, can solve a problem consisting of several hundred thousand operations in approximately 10 seconds, while it takes hours to prepare the problem.

The main shortcoming in the use of large computers is the absence of a flexible system in the computing process.

Translation of the article "Start berut malye EVM" (English version above), in the newspaper *Pravda*, February 24, 1969, p. 3; translated from the Russian by Irene Agnew, February 28, 1969. (File No. 02275N)

When an engineer is solving a problem with a simple slide rule or an adding machine, he obtains and interprets intermediate results, after which he can change the conditions of the problem; he can also introduce corrections at any time during the course of operations. When using the services of a computer center, the client is denied these capabilities. Knowing this, an engineer or a scientific worker often does not use the services of computer centers, but prefers to solve the problems manually. The situation is complicated by the fact that it requires a full working day to solve a problem consisting of a thousand arithmetical operations on a calculating machine. Problems consisting of tens of thousands of operations are beyond the capability of such methods.

Thus, a vacuum of sorts has been created between large computers and secondary methods--slide rules and table-model calculating machines. Small computers of the Mir series have been called upon to fill this vacuum. The Promin', the first of the Mir series, was developed at the Institute of Cybernetics of the Ukrainian Academy of Sciences. It was followed by its "sister," the Mir-1.

The main requirement in the development of these computers was that specialists not acquainted with the programming process could easily use the computers. The goal was to facilitate communication between man and machine.

There are two main trends in computer technology to simplify this "mutual understanding." One of them, pertaining to large computers, involves the use of translators--special programs for translating the conditions of the problem from a language comparatively close to ordinary mathematical notation into a language suitable for computers. The second trend is the development of so-called time-sharing systems, which make it possible for a large computer to be used by several users from consoles outside the computer center.

Another trend, one which pertains to small computers, was realized in the Mir-1. It consists of what is called an interpreter, the essence of which is that the program is given in a language close to the ordinary language of the mathematician, engineer, technician, and scientific worker. The problem is not translated into machine language, but remains in the language used by the person and is interpreted directly by the computer. The "external" and "internal" language of Mir-1 are fused into one, as it were.

Consequently, it is possible for a person to rapidly introduce changes in the program. The advantage, of course, is great. While in other computers it is necessary to process the changes through a translator and each time recompile the program as a whole, this is not necessary when using the Mir-1. Only that part of the program is altered in which the changes are made.

True, the use of an interpreter system significantly reduces the computer's speed. Therefore, the primary goal was to develop a computer which by its internal structure would be optimized for language interpretation. Another problem was to develop methods permitting the significant enrichment of the language used by man in addressing the computer.

It is known that ALGOL--the international, general-purpose language used to write many programs for large computers--does not encompass such well-known mathematical operations as, for example, integration of functions. Each such operation must be programmed separately.

The situation is quite different in the Mir computers. The capability to solve a much greater number of operations than is customary for computers is built into the structure of the machine itself. It is capable of computing the integral, finding the sum of a series, finding the product of an infinite number of multipliers. As a result, the

language used to prepare the computational problem is considerably simpler.

Thus, we have a paradox: in order to be used efficiently, small computers must have a greater capability than their "senior brothers." The capabilities of large computers are stipulated by their previously specified programming systems. In the Mir computer series, a great deal of "intellectuality" is incorporated directly in the computer structure and its capability for "reasoning" is several dozen times greater than that of today's widely-used large computers.

To trade-off a small machine's limited speed and comparatively small memory for greater "intellectuality," the designers had to "rack their brains." The solution was found in the so-called microprogram step control.

The step aspect of control made it possible to divide the control process into several levels. At the first level, the machine is given the most elementary operations; at the second, larger operations; and at the third, complex operations such as numerical integration of functions. The degree of accuracy of calculations and the number of bit positions is determined by the program.

Mir-1 is indispensable for design bureaus; it can be used by physicists, chemists, biologists, power engineers, and personnel in practically all areas of science and technology concerned with mathematics and computer technology. At present, a new computer in the Mir series is being developed at the Institute of Cybernetics.

What was the course of development of the Mir-1 computer?

The machine language and the basic software principles were developed by a group of mathematicians in the theoretical sector at our Institute. Simultaneously, a group in the Institute's Design Bureau took it upon themselves to transform these ideas into metal. But their role was not finished

there. The Bureau workers also made a significant contribution to the development of ideas for the structure of the machine itself.

According to established tradition, an experimental model of the Mir, suitable for series production, was developed jointly by the Institute of Cybernetics and the production plant. As a result, the gap between experimental development of the machine and its introduction into the national economy was reduced to a minimum. It seems that this is one more affirmation of the importance of genuine professional cooperation between theoreticians, designers, and production workers in all stages, from the birth of the idea to its realization in industry.

The design principles of our computer have attracted the attention of foreign specialists. For example, it has been purchased by IBM, the well-known American firm which monopolizes more than half of the computer production of the capitalist world.

Practical experience indicates that interest in small computers is continually growing. This is not accidental. First, the structural design principles of the Mir-1 computer series can be applied in designing large computers. Secondly, the combination of large and small machines in time-sharing systems (systems in which several users have their own terminals and simultaneously transmit problems to the machine, making maximum use of machine time) produces outstanding results. Problems within the capability of small computers are solved immediately. When the machine is not fast enough or has insufficient storage for the solution of long and complex problems, the small computer transfers the problem to a large machine at the computer center. Thus, small computers become the "eyes and ears" of the large machines and connect them directly to the users. The simplicity of use of small computers and the speed of the large computers mutually complement and enrich each other.

Computers are used more and more in the national economy and help to accelerate scientific progress. This is why Soviet scientists enthusiastically and with a sense of great responsibility are working to discover new areas for computer application in the most diverse spheres of human endeavor.

COMMENTARY: The Mir computer was the subject of a feature in our last issue, *SC:RNI*/69/2. That article provided as much information on the Mir software system as has been released; technical specifications of the machine's hardware structure have yet to appear in any detail. The present article effectively places the Mir series within the range of computational capabilities provided by the various Soviet computers. The author, Viktor Glushkov, Director of the Institute of Cybernetics in the Ukraine, makes a strong case for the Mir series and lucidly documents its features and advantages.

The mystery concerning a Mir sale to IBM pops up again in Glushkov's article. Such a claim was first made in *Izvestiya* last October (see *SC:RNI*/68/23, p. 44), and promptly denied by IBM officials (*SC:RNI*/68/23, p. 3). Now, Glushkov has repeated the assertion that IBM has purchased a Mir-1. While other Soviet authors could easily have confused IBM with some other smaller, perhaps British, company to whom a Mir-1 sale had indeed been made, it is difficult to believe that Glushkov could make such an error. On the other hand, it is not at all clear that IBM should be in the market for a Mir machine, except perhaps as a means of entree into a potential market for its equipment.

Glushkov's remarks about incorporation of large and small machines into multimachine, time-sharing systems is perhaps misleading, implying that the Mir-1 operates in such an environment. Such is not believed to be the case. Perhaps, the new machine in the Mir line, to which Glushkov alludes, will be so intended.--WH

State Network of Computer Centers: Development Progress Report

Prof. A. Ya. Boyarskij, Doctor of Economic Sciences, Director of the Scientific Research Institute of the USSR Central Statistical Administration

It has now become an axiomatic principle that further increase in the efficiency of social production depends to a great degree on the extent to which mathematical economic methods are used in planning and managing the national economy. As far as the Scientific Research Institute of the USSR Central Statistical Administration is concerned, the efforts of its staff have been concentrated on the solution of theoretical and practical problems in creating automated systems for processing economic information and the most extensive application of modern mathematical economic methods and computer technology in statistics.

...

Problems of using mathematical economic methods in computer-aided processing of statistical information have also been solved. Now the problem is being raised of the practical use of these methods in the Computer Center of the USSR Central Statistical Administration and the development of standard computer programs and their systems which provide computer solution of a certain class of economic problems.

...

Recently, a group of the Institute's personnel began development of a conjunctional information system. The

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Translation of excerpts from the article "Nauchno-issledovatel'skij institut TsSU SSSR" ("Scientific Research Institute of the USSR Central Statistical Administration"), in the newspaper *Ekonomicheskaya gazeta* (*Economics Gazette*), No. 6, February 1969, p. 15; translated from the Russian by Patricia L. Stephan, February 10, 1969. (File No. 02288N)

distinction between conjunctional and ordinary information lies in the fact that the former does not serve as an individual monitor of the progress of plan fulfillment but inspects the dynamic economic process as such within the framework, for example, of a quarter or even a month. Naturally, the scope of indices through which conjunctional statistics "keeps its hand on the pulse" of the national economy must be significantly wider than the scope of planning indices for an enterprise or branch. We propose to develop new procedures for current or conjunctional information as well as to conduct experimental work on the statistics of short-term forecasting. (For example, the statistics of forecasting an enterprise's demand for labor in each future month or quarter.)

Further perfection of planning and managing the national economy gives rise to the necessity of creating comprehensive automated control systems for separate branches and agencies with their subsequent consolidation into a single automated control system for the entire economy. The State Network of Computer Centers (SNCC) can solve these problems. With its help, it is possible to ensure the efficient interaction of all branches of the national economic control system and a comprehensive solution to planning and dynamic control problems in each branch in less time and with minimal expenditures for transmitting, processing, and reprocessing economic information.

Last year, refinement of the advance design for the SNCC was completed. Institute personnel determined flows and volumes of transient economic information and compiled technical instructions for designing the SNCC, taking into account its interaction with branch and agency systems. Specifications for a complex of computer hardware which is compatible with respect to engineering, coding, and programming, and specifications for the unification of units in digital computers have also been prepared.

Development of the methodological and methodical problems of hardware for the SNCC will be continued this year. In particular, extensive research is planned on the informational requirements for designing and creating SNCC, on a rational organization of computer centers for processing economic information, and on technological plans of a system for machine processing of statistical information.
...

COMMENTARY: The Central Statistical Administration has primary responsibility for the development of the State Network of Computer Centers (SNCC), according to a special resolution adopted in April 1966 by the Central Committee of the CPSU and the Council of Ministers of the USSR (see *SC:RNI*/67/1, pp. 51, 57-58). The present article is one of the first we have seen indicating any substantive progress on the part of the Administration in carrying out its task.

It has been clear for some time that not only is there widespread unhappiness with the entire concept of the SNCC on the part of its detractors, but also that its supporters have been concerned about the competence of the Central Statistical Administration to implement such a system (preferring that the job be given to GOSPLAN). As we have reported several times recently (e.g., *SC:RNI*/68/22, p. 37), there are indications that a territorially based system such as that envisioned will be scuttled in favor of a series of computer center networks, each tied to a particular ministry or agency. Pressure in this direction was originally of a political nature, as government officials grasped the implications of having their information flows controlled by an outside, independent computer agency. More recently, opposition to the original concept of a single, state-wide system has appeared among the computer experts, who question the ability of the state of the art to provide such a gigantic, monolithic computing capability.

Earlier indications were that the SNCC would be implemented in stages, the first to be based on 30 regional and 500 urban centers; a wide variety of existing machines would equip the urban centers, while Ural-11, -14, and -16 computers would be used at the regional installations and at the national center(s). The second stage would see a significant increase in urban centers. It is not clear how this plan meshes with the work of Boyarskij's Institute on

hardware specifications; the Ural-11 and Ural-14 computers do not appear to be performing up to expectations,* and there has as yet been no indication that the Ural-16 has appeared on the scene.--WH

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*See, for example, *SC:RNI*/68/22, pp. 14-15.

Biography of Academician A. I. Berg

Prof. I. V. Brenev

On Nov. 10, 1968, Academician and Engineering Admiral A. I. Berg, an outstanding Soviet scientist, Hero of Socialist Labor, celebrated his 75th birthday.

Aleksander Berg, a Swede by nationality and a druggist by profession, who lived in the last century in the severe northern city of Vyborg, had a son named Ivan, who became an officer. Ivan Aleksandrovich took part in the Russo-Turkish War of 1887-88 and bravely fought in the Russian Army. He retired with the rank of infantry general. Ivan Aleksandrovich Berg was the father of Aksel' Ivanovich.

Another ancestor of Aksel' Ivanovich--Camillo Bertoldi--came from Italy and lived at the beginning of the last century in Tbilisi (Tiflis). His daughter--Elizaveta Kamillovna--was the mother of Aksel' Ivanovich. Elizaveta Kamillovna for many years directed the Marion Lady's School in Tsarskoe Selo (now the city of Pushkin). Margarita Ivanovna--the sister of Aksel' Ivanovich--began her career in this school, where she taught mathematics. Therefore, when Aksel' Ivanovich is asked what his nationality is, he always clearly answers--Russian. And this is really the case. He knows well Russian literature and art. His

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Translation and summary of excerpts from the article "Akselyu Ivanovichu Bergu--75 let" ("Aksel' Ivanovich Berg is 75 Years Old"), in the journal *Radioelektronika* (*Radioelectronics*), No. 10, 1968, pp. 1113-1120; the first four paragraphs are from the article "K 75-letiyu Akselya Ivanovicha Berga" ("The 75th Birthday of Aksel' Ivanovich Berg"), by I. V. Brenev, in the monograph *Kibernetika i nauchno-tekhnicheskij progress* (*Cybernetics and Scientific-Technical Progress*), Znanie Publishing House, Moscow, 1968, pp. 3-17; translated from the Russian by John Schneider, February 12, 1969. (File No. 02294A. Photo: File No. 02230P)

favorite poet is Pushkin. It is likely that not every Russian with an ancient heritage can recite chapters from "Eugene Onegin" by heart; Aksel' Ivanovich, however, can recite whole chapters from this remarkable poem. He is also a serious connoisseur and admirer of Russian music. At one time, he played the violin.

Aksel' Ivanovich does not have the stereotyped characteristics of scientists, who are usually described as being completely absentminded and naive in all business and everyday affairs. Aksel' Ivanovich is first of all a man of action and a model of punctuality. He is a scientist who is a discoverer and an organizer. He is a scientist who can switch from creative work to sports; he is a tennis player, a skier, and a chess player. He is interested not only in professional problems, but also in any other subject which attracts lively, active people of different professions and viewpoints....

During the First World War, A. I. Berg saw combat action in the Baltic as a junior navigator on the battleship Tsesarevich. Being a young officer who knew English quite well, he also served as a navigator on a British E-8 submarine, which belonged at that time to the Russian Baltic Fleet. Finally, in Helsinki in the winter of 1916-17, he graduated from a navigation officers' class. In March 1919, he became commander of the submarine Rys', and served as a commander (on this and other vessels) until the end of December 1922, when he entered the Military Naval Academy....

During his stay at the Academy, Aksel' Ivanovich passed examinations in the complete course of instruction of the Military Naval Engineering School and obtained the rank of fleet engineering electrician (1923). He then began teaching at the school and at the Military Engineering Academy. He wrote and published subject matter for courses in General Theory of Radio Engineering (1925) and Cathode Ray Tubes (1925), and he completed a number of research projects in

A. I. Berg, Chairman of the Scientific Council on Cybernetics of the Presidium of the USSR Academy of Sciences

the area of electronic instruments. Since that time, electronics has occupied the leading place in his scientific work.

Aksel' Ivanovich left the Academy (1925) as a completely qualified young scientist, a skilled military naval engineer, and an accredited teacher in the field of higher education.

...

In 1927, A. I. Berg was assigned to take the place of I. G. Frejman, Chairman of the Communications and Navigation Section of the Scientific and Technical Committee, Directorate of the Navy of the Workers' and Peasants' Red Army. One of his first tasks in his new position was the development of "A System to Arm the Fleet with Communications and Surveillance Hardware." This meant establishing and substantiating on a tactical and technical basis the principles for suitable radioacoustical and hydroacoustical equipment, which then had to be developed and built on the basis of these principles. However, developing such a system first of all required determining the wave length scales and the power of ship and shore transmitters, selecting suitable types of radio receivers, and developing design specifications for the Navy's newly built radio engineering and hydroacoustical hardware, taking into consideration their purpose and the conditions under which they would be used and operated in the fleet.

Aksel' Ivanovich himself played a leading role in solving all these problems.... In order to study foreign developments, he visited Germany twice (1928 and 1930) and the USA once (1929), and he made two trips to Italy (1930 and 1932). These trips usually resulted in the importation of extremely interesting technical literature and commercial brochures; the purchase of various models of radioacoustical and hydroacoustical equipment; and the writing of detailed reports which were useful to the fleet, industry, and institutions of higher education.

...

The Soviet fleet's first system of radio-armament was implemented between the years 1928 and 1934. This system was the result of the first efforts in this direction, and it opened the road to further developments and improvements. For all he had done, Aksel' Ivanovich was awarded the newly established Order of the Red Star (1933).

The 1930s introduced many new events into the life of Aksel' Ivanovich. He received the title of professor (1930) and the scientific degree of Doctor of Technical Sciences (1936). In 1932, he became the director of the Scientific Research Naval Institute of Communications of the Directorate of the Navy, Workers' and Peasants' Red Army.... In 1935, when special military ranks were introduced, Aksel' Ivanovich received the rank of Engineering Flag Officer Second Class.

...

From 1930 to 1931, A. I. Berg published several articles on flat-compounded pulse and varied-load vacuum tube generators. His book, *Teoriya i raschet lampovykh generatorov* (*The Theory and Design of Vacuum Tube Generators*), was published in 1932. A second, revised edition of this book appeared in 1935....

The beginning of the Second World War found Engineering Rear Admiral (1941) Aksel' Ivanovich Berg in Leningrad as a professor at the Military Naval Academy. He evacuated with the Academy, first to Astrakhan' (1941) and then to Samarkand (1942). During the first two years of the war, Aksel' Ivanovich lectured to those who remained with the Academy, worked on individual scientific and technical problems concerning the use of radio engineering hardware at the front, and worked on "The Design of Naval Radio Transmitters," a subject he had conceived of long ago. Unfortunately, this work was not finished and published, for new affairs and responsibilities soon attracted his attention and efforts.

In 1943, Aksel' Ivanovich was entrusted with one of the most important tasks of the day--the introduction of ultrashort wave technology on a state-wide scale. Consequently, in the summer of 1943, he was appointed Deputy People's Commissar of the Electric Industry and at the same time Deputy Chairman of the newly formed Council on Radar under the State Committee of Defense.

Only with the constant and efficient help of high party and government agencies, and also with the cooperation of his own closest associates, did Aksel' Ivanovich succeed in organizing practically from nothing a specialized scientific research institute in an extremely short time (he served as director from 1947 to 1957); in forming working agencies of the Council on Radar which could begin work immediately on general plans for the further development of domestic radioelectronics; and in interesting enterprises in the production of new equipment, electronic instruments, and measuring equipment, at times far from his own primary area of knowledge.

By the beginning of the 1950s, the first stage of the mass development of ultrahigh frequency technology and its various applications was essentially completed. Now, other no less important problems arose: it was necessary to put all this technology into operation and to make it serve those aims for which it was intended.

The place where ultrahigh frequency technology found its greatest application in these years was in the Armed Forces of the USSR. Therefore, in 1953, Engineering Vice Admiral (1944) Aksel' Ivanovich Berg, already an active member of the USSR Academy of Sciences (1946), was appointed USSR Deputy Minister of Defense for Radar (later, for Radioelectronics). He stayed at this post until 1957, but he served as a consultant to the group of general inspectors of the USSR Ministry of Defense until 1960. In 1955, he received the military rank of Engineering Admiral. During

the years Aksel' Ivanovich worked in the Ministry of Defense, the new technology found its proper place in the armament system of the Soviet Army and Navy.

During all these difficult years of establishing the new technology, Aksel' Ivanovich, besides his basic work in this field, considered it absolutely necessary to fulfill many obligations in the USSR Academy of Sciences, various agencies of Gosplan and the Council of Ministers of the USSR, public organizations, and various councils and committees. Through his efforts, the Scientific Research Institute of Radio Engineering and Electronics of the USSR Academy of Sciences was established. He was its first director, serving from 1953 to 1955....

To say that cybernetics is needed by our government and is useful in building communism at a time when popular Soviet literature and widely distributed reference books (for example, *The Concise Philosophical Dictionary*, Gospolitizdat, 1954) defined cybernetics as a "reactionary pseudoscience"--a form of modern mechanism directed against materialist dialectics, is to have courage and a firm conviction that one is right. And not only to say this, but to begin acting, to become a propagandist of new ideas, and to attract philosophers, economists, engineers, biologists, physicians, and teachers to this endeavor--this is the great service of the "farsighted" scientist Aksel' Ivanovich Berg.

"There is no evil without good," says an old Russian proverb. Something like this happened to A. I. Berg when at the end of the 1950s he was hospitalized because of an acute coronary condition. It was then that he began to think seriously of the stability of the human organism and mentally transferred the problem of biological reliability to the sphere of technology. From this time on he became a persistent fighter for the development of stable and zero-defect machines, mechanisms, and electronic

devices, and for the necessity of developing a theory of reliability. The subsequent organization of such research in various scientific and industrial organizations, the publication of abundant literature on this subject, and other measures soon confirmed the correctness and timeliness of Aksel' Ivanovich's views on these problems. At this time he also thought of the necessity for a bolder and more decisive introduction of engineering methods, electronic instruments, and computer technology into the field of medicine. With light irony, Aksel' Ivanovich sometimes speaks in his reports of how he once had the thought of taking frequency readings from the oldest of medical instruments--the stethoscope, and it turned out that the instrument completely failed to correspond to the exact frequency range which was needed to examine a heart disease patient. As a result of this, a new chapter opened in the life of Aksel' Ivanovich--concern for the development of medical radioelectronics, for the training of engineers in this field (a chair and specialization in this field were established for the first time at the Leningrad Electrical Engineering Institute early in the 1960s), and for the introduction of electronic computer technology in medical diagnostics. By now we cannot count the followers of Aksel' Ivanovich in this field.

Cybernetics is a very broad and multi-branched science. Consequently, in recent years, the interests of Aksel' Ivanovich in this science have been broad and varied. To the interests mentioned above we can add the application of cybernetics in the national economy, in management, in teaching, and in military affairs.

From the moment the Scientific Council on the Complex Problem of Cybernetics was organized under the Presidium of the USSR Academy of Sciences, Aksel' Ivanovich has become the generally recognized leader of cyberneticists in the Soviet Union. And since Academician, Engineering Admiral

Aksel' Ivanovich Berg was awarded the title of Hero of Socialist Labor (1963) by the Presidium of the USSR Supreme Soviet, one must suppose that his activities in the field of cybernetics have been one of the most important services he has rendered to his country.

...

One of the mines of the Lenin Coal Trust is equipped with an UM-1 control computer. The machine automatically keeps the time sheet and records how many workers have gone down into the mine, as well as where and at what operations they are working. Source: Ekonomicheskaya gazeta, No. 6, Feb. 1969, p. 4. (File No. 02237P)

o *Aeroflot Automates Reservations and Ticket Sales*

o *Interi[illegible] ystem Uses Mins[illegible]*

The Sirena-1 System for Airline Reservations

V. Simonyants, Chief of the Central Agency of Air Communications, USSR Ministry of Civil Aviation

...

At present, the Central Agency [of Air Communications], following the instructions of the Ministry of Civil Aviation, is taking steps to improve the reference and information work and the sale of tickets at the Moscow air terminal.

This terminal is one of the largest in the world, with more than 25,000 tickets sold daily to Muscovites, and about the same number of tickets to connecting passengers. There are about 8000 flight cards in circulation daily at the reservation bureau of the Central Agency of Air Communications.

If we take into account that the total volume of passenger transportation by 1970 will have increased 1.8 times as compared to 1965, and that by 1975 it will have almost tripled, it is easy to see that the number of operations conducted by the Central Agency of Air Communications will also increase. This is why it was decided to develop the Sirena-1 domestic automated system for seat reservations and ticket sales. Several design and scientific organizations have been involved in the development of the system. The system design basically meets the demands specified by the Central Agency, the scientific computer center, and the Administration of Transport and Commercial Operations of the Ministry of Civil Aviation. The first stage of the system will be put into operation this year, and it will be completed by the end of the five-year plan.*

*1970.--Trans.

Translation of excerpts from the article "Pomoshchnik--Sirena-1" ("The Sirena-1, A Helper"), in the newspaper *Izvestiya*, February 4, 1969, p. 4; translated from the Russian by Irene Agnew, February 10, 1969. (File No. 02255N)

The Sirena-1 system is capable of "storing" all seats for airplanes which are scheduled to depart within a 30-day period from Moscow and several other major airports and for "storing" seats on airplanes returning to the capital. A total of 1100 flights can be programmed in the system.

How will the tickets be sold? The customer will approach the cashier and state the city, the date, and the flight which he desires. The cashier will press the appropriate buttons on a terminal panel, and the customer's data will appear on the display screen before him. After re-checking the data, the cashier will transmit the request to the computer. The computer will immediately reply and indicate on the screen the price, time, and airport for departure. If there are no seats on the flight the customer has requested, the computer will automatically find and report the nearest flight (within the limits of the period for storing reservations) to the desired city. A ticket-printing device (which, by the way, is not used in any system abroad) within 20-30 seconds prints on a blank ticket all the flight information, the price, and the method of payment (cash, check, or transfer). Thus, labor productivity is considerably increased, and passengers are relieved of the necessity of standing in line. With the help of Sirena-1, one cashier can sell up to 600-700 tickets, while at present, a maximum of only 300 tickets is sold during each shift.

The Sirena-1 system will also serve as a central reference and information bureau. From incoming telegrams, it will store information on actual flight times, delays, and changes or cancellations of flights; upon request of the workers of the reference and information department, it will relay this data to the operator display panels. The persons on duty will be able to receive information on prices, routes, and availability of seats. In addition,

information on the availability of seats will be projected on display panels in passenger waiting rooms.

It must be brought to the attention of the USSR Ministry of Instrument Construction, Means of Automation, and Control Systems that at present the development and construction of the Sirena-1 system is behind schedule. This is cause for alarm since the system is awaited by both the workers of Aeroflot as well as the passengers.

Even while the Sirena-1 is being developed and constructed, the number of air passengers continues to grow annually. Therefore, it is necessary to take some kind of measures immediately to satisfy the demand of the population for air transportation and to increase the percentage of seats occupied.

In seeking a way to solve this problem, we visited a computer plant. Our attention was attracted by the new Minsk-23 computer, which has a memory capable of "storing" seats for 500 air flights for 20 days in advance.

A Minsk-23 computer has been installed in the city air terminal and was put into operation at the beginning of last summer's schedule. The computer reserves seats by telegraph requests from agencies and airports in all cities of the USSR. Prior to this, a reply to a telegram was given in five to six hours. Now, 600 telegrams are processed in 16 minutes. In case seats are unavailable for a particular flight, the machine conducts a search for an empty seat on the nearest flight.

In addition to handling seat reservations by telegram, the day before the departure of a flight the Minsk-23 provides final lists of passengers, and the day before the arrival of a flight it provides lists of the connecting passengers who are expected to arrive. In case of delays or cancellations of any flights, the reservations of the connecting passengers are cancelled and tickets are sold for the empty seats; steps are also taken to transport

those who were delayed in Moscow due to circumstances beyond their control. Finally, information is periodically received on the number of occupied seats in each airplane. The computer calculates the unsatisfied demand for seats, thus making it possible to rapidly introduce additional flights.

Gosplan of the USSR and the Ministry of Civil Aviation have been instrumental in the introduction of the Minsk-23 computer. At present, work is being conducted on improving the Minsk-23 complex.

Other new equipment has also been introduced at the Central Agency of Air Communications. One of the innovations is the DPIDS-1 Device for Long-Distance Transmission of Information on Airplane Traffic. All data on the actual flight times and arrival and departure times of airplanes at the large airports of the USSR and airplanes going abroad are fed into the memory unit. The system stores information on 700 flights.

The work of cashiers is also being facilitated. With 150-200 tickets sold daily, a cashier now has to make an equal number of telephone calls and dial seven numbers for each call. To improve this tedious and inefficient labor, the Avtonabor-24 keyboard device, produced by the Perm' Telephone Plant, is being installed in each cashier's booth. The apparatus makes it possible for the cashier to make automatic telephone connections.

Another innovation which must be briefly mentioned is the SINM-1 Seat Availability Information System. The SINM-1 system is valuable since it can be used in any agency, in airports, and in administrations to inform passengers on the availability of seats from one to six days in advance for flights leaving from Moscow airports. In the past, the cashier or the person on duty at the ticket office did not know whether there were seats available on the plane desired by the passenger and had to telephone the Central Reservations Bureau, which suggested another flight when the desired

one was sold out; if the passenger agreed to take this alternate flight, the cashier then had to make another call to the Central Bureau. Now this procedure is unnecessary. Using the SINM-1 control panel, the cashier presses the button of the appropriate flight and immediately receives information on the availability of seats, makes arrangements with the passenger, and only then contacts the Central Reservations Bureau. As indicated by the two-month trial operation of the SINM-1 system, labor productivity has greatly increased.

Of course, it would be unwise to concentrate new equipment only in the Central Agency of Air Communications. Mechanization and automation of production processes must be conducted in all airports and agencies, and the Central Agency must be looked upon as an experimental workshop. After trial operations, systems such as DPIDS-1 and SINM-1 can be used everywhere. The Technical Administration of the Ministry of Civil Aviation, in cooperation with the Administration of Transport and Commercial Operations, has developed a list of standard equipment which should be used to equip various airports and city agencies. Our first responsibility is to increase the efficiency of passenger service. New and up-to-date equipment plays a decisive role in this task.

COMMENTARY: The proposed Sirena-1 airline ticket sale and seat reservation system for Aeroflot marks the first attempt in the Soviet Union to use computers for solving this type of real-time, on-line problem. The Sirena-1 system obviously draws heavily on the experience gained by the various Western airlines. It differs from Western systems in two major respects. First, it is not being designed as a total computerization of Aeroflot's ticket sales and seat reservations. It will apply only in the Moscow area, with what appears to be a tie-in to a few other major airports, mainly for scheduling return flights to Moscow. Second, it will provide one service no Western

system has yet implemented: automated generation of individual passenger tickets.

An interim system, relying on telegraphed requests, has been operating since last summer in the Moscow area to keep track of seat sales and reservations; this system has used a Minsk-23 computer. The Sirena-1 system will be based on special-purpose hardware, the principal unit of which is the M3000 general-purpose processor; implementation details of the Sirena-1 system are contained in the following article in this issue.

A brief criticism of the USSR Ministry of Instrument Construction, Means of Automation, and Control Systems indicates that equipment problems have held up the development of the Sirena-1 system and caused it to fall behind schedule. Public criticism of this ministry is rare, and it will be interesting to see if there is a reply from the ministry.--WH

o Data Processing Center for Aeroflot

o Time-Sharing, Disc Storage Planned

Technical Description of the Sirena System

Yu. F. Bubennov, I. V. Makaranets

The Institute of Automation and Remote Control of the USSR Academy of Sciences, the Scientific Research Institute of Control Computers, and a number of other organizations are developing the Sirena automated system for seat reservations and ticket sales at the Moscow Air Terminal for the USSR Main Administration of the Civil Air Fleet (Aeroflot). The system will provide better service for passengers, increase airplane loading factors, and utilize the statistical materials accumulated by the system for increasing the profitability of air transportation.

The system will be used for the following functions: seat reservations and advance sale (up to 30 days) of airline tickets for 1100 flights a day; refunding money for unused tickets and immediate posting of tickets for resale; processing of telegrams from out-of-town agencies and reservation of tickets for through passengers; issuing information on the availability of seats and flight schedules to passengers and service personnel; accounting for sold and reserved tickets; posting the financial transactions of cashiers, etc.

A distinguishing feature of the Sirena system is its adaptability to changes in equipment and load while in operation. An airline reservation system must allow for considerable fluctuation in the demand for service during different periods of the year, month, or day. At an average

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Translation of excerpts from the article "Sistema rezervirovaniya mest na aviatransporte" ("A Seat Reservation System in Air Transportation"), in the magazine *Mekhanizatsiya i avtomatizatsiya upravleniya* (*Mechanization and Automation of Control*), No. 6, November/Decerber 1968, pp. 13-16; translated from the Russian by Irene Agnew, February 11, 1969. (File No. 02256A)

of 15,000 inquiries/hour, the coefficient of non-uniformity in the average number of requests per hour in the course of the year is approximately seven. The response time of the system per interrogation is limited to 2-3 seconds. High demands are made on the reliability of the system, which must operate round-the-clock.

The Sirena system includes: a data processing center; a set of devices for transmitting data over communication channels; peripheral equipment; an operating system; and software for the solution of basic problems.

The peripheral equipment (cashier and operator panels, reference and information display panels, transportation department consoles) is located in the Central Agency of Air Communications and its departments, the Central Reservations Bureau, the Central Information Bureau, in Moscow airports, and in agencies of other cities.

The nucleus of the system is the data processing center, based on a modular computer configuration.

Due to the logical and structural independence of the system components and the network of specific, standardized communications between them, it was possible to establish a failure-free, multiprocessor, computing and information center with a large set of data processing devices, main and auxiliary storage units, and input-output devices. To ensure high reliability and stability in the system, necessary accuracy in computational results, and flexibility in the utilization of resources, the data processing center was designed as a symmetrical, asynchronous duplex. With this type of arrangement, the data processing center of the Sirena system can provide full-capacity operation for up to five years with only one incorrect ticket for each 100,000 tickets sold.

All units in the data processing center can be functionally divided into four groups: computing units, auxiliary storage units, input-output devices, and distributor-converters.

The computing units are all based on the M3000 general-purpose processors, which can execute a complete set of commands from the computer system at a speed of more than 100,000 opns/sec. Each general-purpose processor is connected to the main storage of its own computing unit and to the main storage of the second half-duplex of the data processing center by first-class inter-system communication devices. The main storage consists of immediate-access storage units and read-only memory devices in blocks of 8192 36-bit words. The total capacity of the main memory of one half of the complex is 3.6×10^5 symbols (bytes). To protect data arrays from operator and programming errors, a memory protect device is used.

Multiplexers and selectors are used for transferring data between the auxiliary storage, the input-output devices, and the main memory. The number of input-output devices addressed and connected to one of the above communication devices varies from 1 to 256. The maximum frequency of information exchange using multiplexer and selector units is 200,000 bytes/sec. Although multiplexer and selector units are arbitrarily divided between the two halves of the complex (six in each), they are equally accessible by both of the center's processors. This provides flexibility in the use of the auxiliary storage and the input-output devices, and a high reliability for the data processing center. Thus, access to identical information stored on magnetic drums is possible by means of any processor through four independent channels.

Magnetic drums, magnetic discs, and magnetic tapes are used for auxiliary storage.

The use of diverse storage devices is due to the large volume of information which must be stored in the system and the various specifications of frequency and speed for its retrieval and processing. Thus, data required for the flow of inquiries in real time (information on seats, routes,

rates for distances, cost of tickets, etc.) comprises about 2×10^6 bytes. A considerable part of this information continually changes, thus it is located in main and auxiliary storage with quick access time. Information on through passengers and on advance seat reservations is processed less frequently. However, the volume of this information is large (more than 5×10^6 bytes), and it is stored on magnetic discs and drums. Magnetic tape storage is used extensively for recording information on completed operations. The volume of statistical information is more than 30×10^6 bytes per day (24 hours).

...All information [in the auxiliary memory] is duplicated. Magnetic drums, magnetic discs, and tape drive mechanisms are subdivided into groups which have independent control devices for magnetic tapes stores, and for magnetic drum and disc stores. To facilitate mutual accessability, commutators are used, thus ensuring the applicability of one control device for two groups of stores.

The set of input-output devices includes: a papertape input device; a papertape output device; a punchcard input device; a programmer's console; and an alphanumeric printer.

Part of the input-output devices are connected to the multiplexer by an inter-component communication device. The large set of input-output devices in the data processing center and the multiprogram organization makes it possible to use machine time to the maximum, loading the data processing center with planning-economic and scientific-technical problems during periods when the demand for ticket sales or seat reservations is low.

The distributor-converters, which consist of a machine linking device and different types of line adapters are used to join the half-duplexes of the data processing center into a single system and to establish communications between the data processing center and the telephone and telegraph communication network. Line adapters provide the physical

linkage with the external communication lines; they receive, group, and edit reports from subscribers and, using the machine linking device, transmit them to the two synchronously operating computer half-duplexes. Prior to transmission over communication channels, the responses are compared in the machine linking device and, after their conversion into a form convenient for transmission, are sent over the communication channels to the subscribers.

The distributor-converters provide for simultaneous communication with more than 500 subscribers (one line adapter for 32 subscribers. Not less than two distributor-converters are used in the data processing center. This is due to the necessity of providing the required number of communication channels and redundancy of the basic comparison unit for the data processing center. Any subscriber can communicate with the data processing center over two independent channels, which are connected to different distributor-converters. All the distributor-converters in the center are equivalent, and a failure of one can lead to some decrease in the capacity of the system.

The use of several different types of line adapters is required by the variation in the parameters and algorithms in the operation of existing standard telephone and telegraph communication lines. The existing communication network is widely used in the system to transmit discrete information between subscribers and the data processing center. Communication is partly conducted over fixed communication channels. In this case, the communication lines are equipped with data transmitting equipment, consisting of channel generating instruments for increased reliability. The use of data transmitting devices makes it possible to increase the reliability of the transmitted information up to 1×10^{-7}. Communication is also partly conducted over the subscribers' telegraph switchboards.

Subscribers communicate with the system by using different types of terminals--from special-purpose, operator consoles and data-inquiry devices to the simplest telegraph instruments.

Operator consoles are used to collect data on passenger departures, for visual monitoring of information via television, transmission of data over communication lines, reception and routing of replies, and automatic printing of airline tickets on special forms.

The information-reference devices can be used collectively and individually. Some types of inquiries are output in printed form; others are displayed on a screen.

Of special interest is the organization of the operational modes of the data processing center. The redundancy of equipment and appropriate control and diagnostic programs make it possible to automatically readjust the structure of the data processing center for the different problems to be processed and the capabilities of the equipment.

The following basic modes of operations are provided for in the data processing center: asynchronous duplex mode; simplex mode, in which the data processing center is divided into two independent subsystems, each solving different problems (in this case one of the subsystems can be undergoing servicing); the multisystem mode, when the two subsystems are independently solving different parts of a common problem; and the servicing-diagnostic mode.

When solving basic problems in real time, the data processing center usually operates in the asynchronous duplex mode.

Any data from the distributor-converters enters both computing units and is processed by them independently for an unspecified length of time. This provides two independent computation results in different periods of time which have been subjected to different external influences (surges in the power system, failures, etc.). This reduces

the probability of identical errors almost to zero and provides the necessary accuracy of computations. The responses are compared prior to their transfer to the distributor-converters. In case of discrepancies, computations are repeated. If the discrepancy persists, the data processing center changes to the diagnostic mode of operation. The diagnostic mode of operation makes it possible to localize the malfunctioning area and to readjust the work of the data processing center. The first stage of the Sirena system will be introduced in 1969.

o Staff, Courses, Research Trends

o Setun', Strela, M-20, BESM-4

o BESM-6 Software

The Chair of Computer Mathematics and the Computer Center of Moscow University

I. S. Berezin

The appearance of electronic computers and their application in various branches of science and technology have raised the question of training mathematicians capable of effectively using modern computers to solve various mathematical and applied problems, including those which might arise during this process. Consequently, the Chair of Computer Mathematics was organized in 1949 in the Mechanics and Mathematics Faculty of Moscow University. Until 1952, the chair was directed by Professor B. M. Shchigolev; from 1952 to 1960, by Academician S. L. Sobolev; and since 1960, by Academician A. N. Tikhonov. At the present time, the chair is staffed by:

Corresponding members of the USSR Academy of Sciences--

S. S. Lavrov, A. A. Samarskij, and L. A. Lyusternik;

Professors--

N. S. Bakhvalov, I. S. Berezin, Yu. B. Germejer, and M. R. Shura-Bura;

Docents--

F. P. Vasil'ev, A. D. Gorbunov, E. G. D'yakonov, N. P. Zhidkov, V. G. Karmanov, N. N. Kuznetsov, V. V. Rusanov, N. P. Trifonov, and L. A. Chudov;

Translation of excerpts from the article "O kafedre vychislitel'noj matematiki i vychislitel'nom tsentre Moskovskogo universiteta" (English version above), in the journal *Vestnik Moskovskogo universiteta, Seriya I, matematika, mekhanika (Journal of Moscow University, Series I, Mathematics, Mechanics)*, No. 6, Nov./Dec. 1967, pp. 52-60; translated from the Russian by John Schneider, February 18, 1969. (File No. 02257A)

Associates--

A. B. Bakushinskij, V. K. Vlasov, A. N. Sokolikhin, and I. F. Sharygi

To aid the teaching process and the development of scientific work in the field of computer mathematics, and to conduct calculations for the scientists at the University, the Computer Center was established in 1955. It works in close contact with the Chair of Computer Mathematics. At the present time [Nov. 1967], the Computer Center operates four electronic digital computers: the Strela (acquired in 1957), the Setun' (acquired in 1959), the M-20 (acquired in 1961), and the BESM-4 (acquired in 1966). On the staff of the Computer Center is a relatively large number of mathematicians, including one doctor and 15 candidates of sciences. The scientific associates of the Computer Center are a great help to the Chair of Computer Mathematics in the educational process: they teach special courses, and they supervise practical training, seminars, course, and degree work. Students of the Chair receive applied training in the Computer Center.

...

The rapid development of computer mathematics and the emergence of new trends and areas for applying mathematical methods and computers have demanded a constant extension of the list of special courses and seminars [offered by the Chair of Computer Mathematics]. During the early years, the subject matter of special courses and seminars was mainly devoted to numerical methods of solving classical mathematical problems; later on, the spectrum of subject matter widened considerably. As an illustration, we cite the list of special courses offered by the Chair during the 1966-67 school year:

Numerical methods of algebra (V. V. Voevodin);

Difference equations and differen e methods of solving Cauchy problems for systems of ordinary differential equations (A. D. Gorbunov);

Optimal methods of solving differential equations (N. S. Bakhvalov);

Economical difference schemes for solving partial differential equations (A. A. Samarskij);

Difference methods for solving multivariate problems in mathematical physics (E. G. D'yakonov);

Numerical methods of solving elliptical equations (V. B. Andreev);

Selected questions in the approximate solution of ill-defined problems (A. B. Bakushinskij);

Methods of solving unstable problems (V. A. Morozov);

Methods of solving extremal problems (B. T. Polyak);

Mathematical programming (V. G. Karmanov);

Numerical methods of solving optimal control problems (B. M. Budak, F. P. Vasil'ev);

Functional analysis and computer mathematics (L. A. Lyusternik);

Numerical methods in the mechanics of continuous media (G. S. Roslyakov, L. A. Chudov);

Introduction to multivariate problems of gas dynamics (V. V. Rusanov);

Boundary value problems of electrodynamics and integral equations (V. I. Dmitriev);

Multichannel and multiphase servosystems (G. P. Klimov);

Mathematical problems of structural analysis (N. P. Zhidkov);

Methodological and mathematical bases of operations research and game theory (Yu. B. Germejer);

Automatic data processing (S. S. Lavrov);

Syntactically controlled translators (E. A. Zhogolev);

Design of digital computers (V. A. Fedoseev);

Analog computers for calculation and control (V. B. Ushakov).

...

At the present time, the following trends can be distinguished in the scientific work of the Computer Center and the Chair of Computer Mathematics:

1) Automatic programming and software for electronic digital computers;
2) Numerical methods of solving classes of typical mathematical problems;
3) Numerical methods of solving aerohydrodynamic problems;
4) Numerical methods of solving boundary value problems in electrodynamics;
5) Numerical methods in the structural analysis of crystals;
6) Research in the field of computer hardware.

...

In 1963, research was initiated on algorithmic languages, on the application of the ALGOL-60 language, on efficient translation principles, and on the development of translators for the ALGOL language for conversion to the languages of specific computers. In particular, a translator was developed for a version of the ALGOL language for the Setun' computer. In 1965, work began on the development of operating systems and automatic programming systems for the BESM-6 computer. In addition, research is being conducted on the processing of symbolic data on digital computers. Part of the results of all this research has been published in a number of journal articles and in the collections:

Vychislitel'nye metody i programmirovanie (Computing Methods and Programming), Vol. V, edited by A. D. Gorbunov, V. I. Dmitriev, and E. A. Zhogolev, Moscow State University Publishing House, 1966;

Vychislitel'nye metody i programmirovanie (Computing Methods and Programming), Vol. IX, edited by E. A. Zhogolev, G. P. Klimov, and B. T. Polyak, Moscow State University Publishing House (at press).

Under the direction of E. A. Zhogolev, work was begun in 1958 on the development of a software system for the Setun' small digital computer. Several interpreter systems have been developed and implemented, such as the POLIZ system--a very convenient programming method. A translator for a variation of the ALGOL language as well as a number of standard programs for solving typical mathematical problems in various systems have been developed. Results of this research are included in the collections mentioned above, in a number of journal articles, and in the series:

> *Seriya "Matematicheskoe obsluzhivanie mashiny 'Setun'"* (*Series: "Software for the Setun' Computer"*), edited by E. A. Zhogolev, Moscow State University Publishing House, 17 volumes published between 1964 and June 1967.

In the field of automatic programming and software, an adequately general-purpose system of programming, based on a compiler program and with extensive use of conditional addresses and a library of standard subroutines, was developed and implemented during 1954-1960 under the direction of E. A. Zhogolev, N. P. Trifonov, and M. R. Shura-Bura; a set of programs for automating the process of debugging programs and checking computations was also developed. This system was successfully utilized in the Strela computer and later in the M-20. During this period, a compiler was developed for the Strela. The results of these research efforts have been published in a number of journals and in the collections:

> *Sistema avtomatizatsii programmirovaniya* (*An Automatic Programming System*), N. P. Trifonov and M. R. Shura-Bura (eds.), Fizmatgiz, Moscow, 1961;
>
> *Vychislitel'nye metody i programmirovanie* (*Computer Methods and Programming*), Vol. I, N. P. Trifonov, G. S. Roslyakov, and E. A. Zhogolev (eds.), Moscow State University Publishing House, 1962.

...

In 1956, under the direction of N. P. Brusentsov, work was begun on the logical structure and hardware implementation of small automatic digital computers utilizing trinary number representation and high-speed magnetic amplifiers as logic elements. A system of highly reliable logic elements based on a high-speed magnetic pulse amplifier was developed. By 1960, the Setun' digital computer was developed, and in 1962 serial production of the computer was begun. For developing the Setun' computer, Moscow University was awarded a first-degree certificate at the Exhibit of National Economic Achievements, and the chief designers were awarded gold, silver, and bronze medals at the Exhibit. Subsequently, work continued on improving the computer, on developing a new set of reliable and economical elements, and on developing logic structures for small electronic digital computers and for individual devices. In the Laboratory of Electronic Digital Computers of the Computer Center, work has been systematically conducted on increasing the reliability and expanding the possibilities of the electronic digital computers now in operation.

...

COMMENTARY: Although somewhat dated, this article provides a good look at the computer science curricular and support activities of Moscow State University. This is undoubtedly the best equipped university computer center in the Soviet Union. It does not have the latest available equipment, but must be considered to have an adequate array of computers by Soviet standards. Its Setun' and Strela machines can only be considered anachronisms, while the M-20, although capable of a fair amount of production work, is difficult to program. The BESM-4 is more recent and better suited to an educational environment. However, it is not clear that the University Computer Center exists to any significant degree as a pedagogical instrument.

The article mentions the Setun' computer, which was developed at the University Computer Center, initially as a student project. It is probably the only base-three

machine ever to be serially produced. (See *SC:RNI*/67/11, pp. 16 and 79-80; and *SC:RNI*/68/19, p. 11.)

In recent years, the Center has played an important role in software development, as indicated by its responsibility for developing operating and automatic programming systems for BESM-6 and by its work on ALGOL translators.--WH

Inefficient Use of Scientific Manpower

V. Poshataev, Yu. Poshekhonov, Graduate Students of the Academy of Social Sciences of the Central Committee of the CPSU

...

Academician M. A. Lavrent'ev once mentioned that "a scientist's time is a national resource and should be used carefully and economically." Unfortunately, this is not always the case. Sociological investigations conducted in several large scientific research institutes by the Chair of Scientific Communism of the Academy of Sociological Sciences under the CPSU Central Committee indicated that about half of the subjects polled (a total of slightly less than 700 questionnaires were distributed) consider that they are not working at full efficiency.

As a result of processing the data, it was found that research activity alone (conducting theoretical and experimental work, collection and processing of research materials, compilation of reports and articles) takes up only 61.5 percent of the scientist's working time.

In some institutes, the senior scientific associates--the most qualified staff--use almost half of the work day for incidental duties. The same data, with minor variations, was obtained by Novosibirsk researchers, who twice conducted a time analysis of scientific workers in several Novosibirsk institutes.

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Why are the workers of some scientific research institutes not working at full capacity? What are the channels through which the precious time escapes? The word "precious" is not used here as a metaphor; economists have calculated

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Translation of excerpts from the article "Rabochij den' uchenogo" ("The Work Day of a Scientist"), in the newspaper *Pravda*, February 6, 1969, p. 2; translated from the Russian by Irene Agnew, February 13, 1969. (File No. 02248N)

that on the average each scientific worker in the USSR is instrumental in increasing production by approximately 50,000 rubles annually. There are more than 800,000 scientific workers in the country, which clearly indicates the value of even one lost minute of a researcher's time.

Channel I

It is sometimes said that it is difficult to draw a definite distinction between basic and secondary scientific work. It is true that the distinction is flexible. However, almost everyone will agree that making elementary drawings is not the basic duty of a professor or a doctor of sciences. This job can be easily done by a specialist with lower qualifications. However, according to the data from our investigation, working below one's qualifications is not out of the ordinary in science.

...

According to one researcher, a scientist with the highest qualifications uses an average of not less than two hours a day for mechanical work--i.e., up to 90 eight-hour working days, or three months annually. This is one-fourth of all his creative activity. The waste is obvious.

In general, a large portion of working time is taken up by searching for information. It was calculated that if the time wasted by Soviet scientists on the purely technical functions of searching for scientific information were cut in half, it would be equivalent to increasing the number of scientific workers by 100,000 persons.

The shortage of auxiliary workers in various fields is apparent in all research organizations. In the investigated institutes, the ratio between scientific workers and auxiliary personnel (technicians, laboratory workers) was typically 2:1, and only in a few cases--1:1. At the same time, in the opinion of the majority of the subjects polled, there should be two or three technicians and laboratory workers for each scientific worker (engineer).

It would seem at first glance that such recommendations involve large expenditures. However, this is not the case. The expenditures would be compensated for by the savings in time and in wages of the highly qualified personnel. Unfortunately, staffing reforms are, as a rule, one-way: the number of auxiliary workers--laboratory technicians, messengers, secretaries--is decreased. One scientist very neatly stated, "One more cut in our institute's personnel and the guard at the entrance will be replaced by a candidate of sciences." There is some truth in this ironic phrase, since in many institutes many auxiliary functions are fulfilled by qualified scientific workers.

Of course, changing the ratio between the basic and the auxiliary manpower will not in itself relieve the qualified workers from mechanical labors. It is possible to assign a secretary to each senior scientific worker, but there will still be "auxiliary operations" conducted by the scientists themselves unless the rights and duties of all staff positions are more clearly defined. Unfortunately, there are no precise definitions of duties for workers in research institutes. They must be established.

A precise definition of duties cannot be mistaken for a strict regimentation of the scientist's activity. To save time, in some institutes it is forbidden to read literature on the research subject during working hours. It is clear that the conditions for creativity in such scientific institutions will deteriorate. Excessive regimentation as well as an absence of specific duties decreases personal responsibility and lowers the efficiency of labor.

Channel II

Consider the two figures--24.2 percent and 26.9 percent. The first indicates the time lost on administrative work; the second indicates time spent waiting to confer

with department heads, obtaining approvals and signatures, and delays due to interruption of supplies. The figures are impressive. But more impressive is the fact that the greater a scientist's qualifications, the more of his time is spent on scientific-organizational work. In the investigated institutes, senior scientific workers spent 16 percent of their effort on this type of work, while department heads spent up to 70 percent of the total time devoted to a project on scientific-organizational work.

Paradoxically, the more qualified and highly paid workers have less opportunity to conduct research. To find a way out of this situation they extend their working day, take work home, and often work evenings or on days off. This has a negative effect on labor productivity. N. Vvedenskij, an outstanding Russian physiologist, correctly noted that as a rule scientists become tired and exhausted, not so much from working a lot, but, in the majority of cases, from poorly organized work.

Organizational-administrative work in research organizations is necessary. Without it, it is impossible to raise the efficiency of science. Material-technical supply for research is especially important, But it is not necessary for laboratory department heads to spend hours visiting the various enterprises and services. Let this be done by the suppliers. To make purchasing agents out of scientists is, to say the least, unprofitable.

An analysis of documents, applications, and reports, as well as conversations with scientific workers, indicate that in any institute it is possible to cut in half the various kinds of paperwork (superfluous accounting, collection of unnecessary signatures on unimportant letters and applications, etc.). Another way of conserving time is by regulating meetings, which often take up the most productive morning hours. In some institutes, a strict rule has been introduced to hold meetings at the end of

the working day, for the shortest period possible, without unnecessary words, debates, or discussions; in the morning, no outsiders, or even workers of the same institute, are allowed to enter the laboratory. The scientists are involved only in creative activity.

It is not necessary to waste time waiting to talk with department heads. Appointments can be made by telephone, since it is much better to know ahead of time when the director or a deputy director of the institute is planning to see you.

Channel III

Recently, by referring to an academic directory, we telephoned the offices of several scientists and found very few of them in their office. One was attending the district committee Party meeting, a second was at a pre-election meeting, a third was participating in a committee for checking the work of an affiliated institute. This was the usual picture.

The overloading of scientists with public duties is one of the most serious sources of loss of working time. These duties are conducted during working hours and, as strange as it seems, the rule is that the more important the scientist, the more work is "loaded" on him. The Novosibirsk investigators calculated that junior scientific workers have on the average 1.2 commissions; senior scientific workers, 1.6; heads of departments, sectors, and laboratories, 2.5; and deputy directors for science, 4 commissions.

There is no need for comments. Although it is necessary to attract scientists to public work, it is wrong to misuse their time. Unfortunately, the junior personnel in many institutes do not carry out any public duties.

Instead of an Epilogue

A scientist's time is truly valuable. Vast resources are spent on research; in turn, society expects a great deal from researchers. The success of a task, as is indicated by data, depends on both the efficient use of working time and on creative effort. It is no accident that the Central Committee of the Party and the USSR Council of Ministers are giving serious attention to this matter in their decree, "On Measures for Increasing the Efficiency of the Work of Scientific Organizations and Accelerating the Use of Scientific and Technical Achievements in the National Economy."*

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*See *SC:RNI*/68/24, pp. 9-17.--Trans. Edit.

c Generalized System to be Developed

o Kiev Institute of Cybernetics

The Lvov Production Control System

The Presidium of the Ukrainian Academy of Sciences heard and discussed a report by V. I. Shurykhin, Candidate of Technical Sciences, "On the Development of Research on Creating and Introducing into the National Economy an Automated System to Control a Mass Production Enterprise." The Presidium noted that scientific research conducted at the Institute of Cybernetics of the Academy of Sciences, Ukrainian SSR, in the fields of theoretical and engineering cybernetics, especially the study of the problems of remote control and algorithmization of production processes, has enabled a group of workers at this Institute to successfully develop an automated production control system (the Lvov system).

The Lvov Information Control System is a combination of technical programming and organizational measures which make it possible to solve various economic planning problems, improve administrative and economic management of a factory, and raise the efficiency of production itself.

The technical specifications and library of software programs indicate the system's general-purpose character, which makes it possible to use this kind of system in large-scale production enterprises.

The Presidium of the Ukrainian Academy of Sciences praised the work of the Academy's Institute of Cybernetics on developing the Lvov system, and assigned the Institute

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Translation of the article "Pro rozvytok doslidzhen' po stvorennyu ta vprovadzhennyu v narodne gospodarstvo avtomatyzovanoi sistemy keruvannya pidpryyemstvom z masovym kharakterom vyrobnytstva (systema 'l'viv'") ("On the Development of Research on Creating and Introducing into the National Economy an Automated System to Control a Mass Production Enterprise (the Lvov System)"), in the journal *Dopovidi Akademii nauk Ukrains'koi RSR, seriya A--fizyko-tekhnichni ta matematychni nauky (Reports of the Academy of Sciences of the Ukrainian SSR, Series A--Physicotechnical and Mathematical Sciences)*, No. 10, 1968, p. 960; translated from the Ukrainian by John Schneider, February 10, 1969. (File No. 02236A)

the task of completing work on the development of another line of the Lvov system, including the development of the Lvov system to the level of a standard system for large-scale production enterprises with a small inventory of products, and also including the examination of the possibility of using the Lvov system to automate administrative control and engineering work in establishments of the Ukrainian Academy of Sciences.

In addition, the Institute of Cybernetics and the Institute of Economics of the Ukrainian Academy of Sciences were assigned the development and submission for inspection by the Presidium of measures for conducting special comprehensive research on economic cybernetics and the development of automated planning and management systems for individual areas of the national economy. These measures should be ready within one month.

The Bureau of the Department of Mathematics, Mechanics, and Cybernetics of the Ukrainian Academy of Sciences recommended that a conference be held in the third quarter of this year in Lvov in order to become acquainted with the state of work on the introduction of anogher line of the Lvov system and in order to determine the measures necessary to complete this system at the level of a standard system for large-scale production enterprises.

COMMENTARY: The Lvov System, developed under the direction of Academician Viktor M. Glushkov at the Ukrainian Academy of Sciences' Institute of Cybernetics, has been installed at the Lvov Television Factory, and is basically a management control system with some production control functions. It has been highly successful, and is frequently mentioned as a model for advanced management and production automation. It is based on the Minsk-22 computer, and has been reported a number of times in *SCIENI* (see the 1967 and 1968 indexes in the Organizations Section under "Lvov TV Factory").

The current system was tailored to the Lvov TV Factory application, and appears to have undergone considerable

on-site refinement. The present article is concerned with the Ukrainian Academy of Sciences' charge to the Institute of Cybernetics to generalize the system for application in a wide range of factories engaged ir mass production of a limited variety of products.--WH

The Fiftieth Anniversary of the Ukrainian Academy of Sciences

V. Glushkov, Vice-President of the
Academy of Sciences, Ukrainian SSR

The Ukrainian Academy of Sciences was established 50 years ago in February 1919; it had three institutes and 26 chairs with a staff of 140 workers. Today, Ukrainian science leads the country in certain fields. The more than 10,000 scientific workers of the Academy's institutes determine the present and future scientific trends of the Ukraine.

Especially rapid development in the Academy's institutes has been evident in the leading branches of science: mathematics, cybernetics, material science, physics, geology, chemistry, and biology. Achievements in these areas are closely associated with the names of A. A. Bogomolets, N. M. Krylov, V. Ya. Yur'ev, D. K. Zabolotnyj, V. I. Vernadskij, E. O. Paton, M. A. Lavrent'ev, N. N. Bogolyubov, and other outstanding scientists, who have established widely acclaimed schools of fundamental and applied sciences in the Ukraine.

The last ten years have seen a period of rapid development for the Ukrainian Academy of Sciences. New research departments have been added for the solution of important problems of cybernetics, semiconductor technology, radiophysics, physics of low temperatures, theoretical physics, and colloidal chemistry.

The organization of institutes in these fields indicates the level of scientific development in the Ukrainian Republic and its role in the present scientific and technical

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Translation of excerpts from the article "Polveka poiskov i otkrytij" ("Half a Century of Research and Discoveries"), in the newspaper *Izvestiya*, February 13, 1969, p. 2; translated from the Russian by Irene Agnew, February 26, 1969. (File No. 02265N)

revolution, which is creating an upheaval in different branches of industry.

Scientific-technical progress today is one of the main areas of the historical competition of the two systems. Therefore, the problems of scientific development and the rapid introduction of scientific achievements into production demand an approach which permits a simultaneous solution of both today's problems and the important problems of tomorrow.

As an example, I shall mention an area close to me. Last year, the State Commission approved the Lvov system, an electronic system capable of optimizing production control at large enterprises. It was developed by the Institute of Cybernetics and the Lvov TV Factory. In addition to its specific purpose for individual plants, this system has an important scientific implication which will make it possible to include it later in an all-union control system for the national economy. This system is still being developed and is the long-range goal of scientific research.

In other words, we are concentrating our efforts on the solution of practical problems which yield the information necessary for further theoretical development, in order that the latter extend the path for the solution of tomorrow's practical problems. Such an approach to the solution of today's industrial and scientific problems, in our opinion, greatly increases the efficiency of our highly qualified personnel and makes it possible to place before them problems whose solution will determine the development of the entire national economy for the next ten years and contribute to the improvement of the people's working and living conditions.

...In order to accelerate the tempo of technical progress it is necessary to increase the efficiency of scientific organizations and to remove the obstacles preventing rapid utilization of the results of scientific research in

the national economy. There must be a flexible economic bond between scientific research institutes and enterprises, including joint financial responsibility for the quality of the completed work and the time required for its introduction. And there must be a possibility of using a specific portion of the profits as an incentive to the workers....

SNOBOL Adopted for Soviet Computers

S. S. Lavrov

Special languages are necessary to describe the non-arithmetical processes of data manipulation. A number of such languages to process arbitrary sequences of symbols have been proposed abroad: LISP, IPL, COMIT, SNOBOL, etc. Specific proposals have been made to introduce an extremely simple facility for processing strings and symbols in such computation oriented languages as ALGOL and FORTRAN. Such a facility has also been provided for the ALGEC language, which is intended for economic problems. In the Soviet Union, a translator for a simple language which permits the processing of textual data has been developed for the Minsk-2 computer. In order to take the next successful step in this direction, it is necessary to find a sufficiently simple but efficient language as the basis for describing such algorithms. As a result of research and the comparison of various languages suggested for this purpose, it was decided to adopt the SNOBOL language. The design of this language, as its authors indicate, takes into consideration their experience in working with other, similar languages--COMIT and SCL--and, apparently, it has the necessary qualities. It is not difficult to notice that the basic idea of this language has as its origin A. A. Markov's standard algorithms, the potential and applicability of which are well-known. For greater flexibility it was decided (possibly, because of the personal preferences of the author) to partially "ALGOLize" this language...

Translation of excerpts from the monograph *Snobol-A. Yazyk dlya obrabotki strok* (*Snobol-A. A String Manipulation Language*), USSR Academy of Sciences Computer Center, Moscow, 1968, pp. 3 & 15; translated from the Russian by John Schneider, February 10, 1969. (QA76.5,L41s) (File No. 02235B)

At the present time, the Computer Center of the USSR Academy of Sciences, in cooperation with other organizations, is developing a translator for the SNOBOL-A language for the BESM-6 and M-20 computers...

PRESS REVIEW, FEBRUARY 1969

This section contains annotated listings of articles and photographs in the Soviet popular press dealing with cybernetics, computer technology, and general science. The listings are arranged chronologically by newspaper. Each entry abstracts the item, followed by the publication date, page number, and transliterated heading (where applicable). Any information on translation of the item follows in square brackets.

This issue covers February issues of the daily newspapers **Pravda** (the Party organ), **Izvestiya** (the Government organ), and **Krasnaya zvezda (Red Star,** the military paper); and the weeklies **Ekonomicheskaya gazeta (Economics Gazette), Nedelya (This Week,** the Sunday supplement magazine to **Izvestiya),** and **Moscow News** (an English-language paper). Compiled by Irene Agnew, Dorothy McDonald, John Schneider, and Patricia L. Stephan.

PRAVDA—ARTICLES

A1. **A scientist's working schedule** is analyzed, conditions which promote inefficient use of time are indicated, and suggestions are made for improving the situation (February 6, p. 2, "Rabochij den' uchenogo"). [See **SC:RNI,** this issue, "Inefficient Use of Scientific Manpower."]

A2. **A complaint is voiced** by V. Volchkov, head of the National Control Group of the Ivanovskij Scientific Research Institute of the Cotton Textile Industry, that 16 of the Institute's completed designs for automated equipment have not been introduced into industry. The Institute's plans are not coordinated with the plans of the appropriate ministries and departments. The plans do not specify the production plant and the supply sources, and they do not include the signatures of persons in charge of introducing scientific work into industry. For these reasons, the introduction of new equipment is greatly delayed (February 6, p. 3, "Poryadok plodyashij besporyadok").

A3. **Cast microconductors** filled with molten metal can operate under high and low temperatures (from -60 to + 500), in strong magnetic and electrical fields, in the presence of radiation, and in corrosive media and vacuums. The new cast microconductors are characterized by their minute diameter, durability, high insulation breakdown voltage, and high gating circuit density. Their application will make it possible to decrease the size of radioelectronic and computer elements dozens of times. The principle of producing cast microconductors in glass insulators was suggested by the inventor, A. V. Ulitovskij. Soviet specialists have developed the equipment and the processes for industrial production of microconductors (February 7, p. 3, "Novinki elektrotekhniki").

A4. **The Sebryakovskij plant** in the Volgograd Oblast' reports that cement-loading operations will be completely mechanized this year. An automated system for controlling production processes using computers will be introduced in 1970 (February 8, p. 1, "Bol'shie tsementa strojkam").

A5. **Thirty-thousand engineers and workers** in Kiev are attending "People's Universities." There are 58 "People's Universities" in Kiev. The Kiev Party Committee intends to increase that number and to establish them at scientific research institutes and institutions of higher education (February 11, p. 2, "Narodnye universitety").

A6. **The "Svetlana" Association** of Leningrad, which produces electronic instruments, is an example of one of the three types of industrial associations which predominate in Leningrad. All enterprises belonging to associations of this type lose their independence and corporate rights, becoming production departments of the association. In the other types of associations, specific enterprises may or may not lose their independence while belonging to the association. Experts claim that associations of the "Svetlana," or the "Elektrosila," type are better, since it is easier to introduce new technologies because the concept, research, design, and production become a single process adhering to a common schedule. Several new associations are currently being established in Leningrad (February 12, p. 2, "Firmy Leningrada").

A7. **Academician B. Paton,** President of the Ukrainian Academy of Sciences, discusses the work of the Academy on the occasion of its fiftieth anniversary (February 12, p. 3, "Putyami nauchnogo derzaniya").

A8. **Blagoveshchensk River School** is one of the oldest educational institutions in the Far East. The newly constructed four-story building includes rooms with automatic navigation equipment, programmed instruction devices, etc. (February 12, p. 3, "Blagoveshchenskoe rechnoe uchilishche").

A9. **The Moscow Transport Administration of Civil Aviation** is planning to introduce automated landing control systems and to establish at Vnukovo Airport an information and computer center (February 20, p. 1, "Skorost', udobstva, chetkost'").

A10. **The remote control and automated systems** which have been introduced in the petroleum industry of the Tatar ASSR have not produced sufficiently positive results. The All-Union Scientific Research Institute of Complex Automation of the Oil and Gas Industry created the automated system introduced in Leninogorsk. The system was poorly developed, not adequately tested, and obsolete. In the last eight-ten years, more than 20 different remote control systems

have been introduced, and not one of them is operating at its full capacity today. There is not a single industry in the Tatar ASSR with a completely automated production cycle. The reason for this is said to be the lack of a single plan for the development of automated systems. There is a need to establish a scientific production firm which would have its subdivisions in all large petroleum enterprises and be in charge of installation and adjustment of automated systems (February 25, p. 2, "Trudnyj put' avtomatiki").

IZVESTIYA—ARTICLES

A11. **The Moscow Likhachev Plant** is planning to establish four highly mechanized shops and to introduce 12 automated and 45 mechanized production lines, thereby increasing labor productivity by 50 per cent (February 1, p. 1, "Estafeta sorevnovaniya").

A12. **V. P. Elyutin,** the USSR Minister of Higher and Secondary Specialized Education, reported that in October 1968 there were 44 universities in the USSR with 470,000 students enrolled (221,000 in day sessions); 58,400 young specialists graduated during the preceding year from the universities. A new university has been established in Krasnoyarsk, and universities are being established now in Kuibyshev, Gomel', and Ordzhonikidze, and at Elista in 1970. The university structure remains the same, with six chairs in the natural sciences and six in the humanities. Some universities have engineering-economic and medical departments; they are organized when the establishment of specialized institutions of higher learning is impractical (February 1, p. 6, "Ot rabfaka do universiteta").

A13. **Moscow industry** plans to mechanize production processes in four enterprises and 205 sections and to install 530 automatic and semiautomatic lines, freeing 4500 workers to do other production work. In addition, 930 new machines, assemblies, and materials will be developed and serially produced, and 400 models of presently produced equipment will be improved. All this will be accomplished by 1970 (February 2, p. 1, "Slovo truzhenikov stolitsy").

A14. **The Glukhov Cotton Textile Combine** is being automated and mechanized. By the end of 1970, a shop for control and measuring devices and automation will be constructed, and four automatic lines will be installed (February 4, p. 1, "Prizyv tekstil'shchikov").

A15. **The Sirena-1 system** for airline seat reservations and ticket sales is described (February 4, p. 4, "Pomoshchnik Sirena-1"). [See **SC:RNI,** this issue, "The Sirena-1 System for Airline Reservations."]

A16. **The Lenin October Railroad** reports that most of its towing operations have been transferred to remote control. Computers are used for the control and planning of transfer and sorting operations. The second sequence of the information- planning system for the Leningrad junction will be introduced during the current five-year plan (February 8, p. 1, "Rubezhi tekhnicheskogo progressa").

A17. **The annual meeting** of Ukrainian scientists, dedicated this year to the 50th anniversary of the Ukrainian Academy of Sciences, was opened in Kiev by B. E. Paton. The Academy presented diplomas to researchers who earned the title of "outstanding scientist" (February 8, p. 6, "Sobranie uchenykh Ukrainy").

A18. **Leningrad State University** is celebrating its 150th anniversary. At present, there are 20,000 students, including 1500 graduate students and 800 representatives from foreign countries, studying at the University (February 9, p. 4, "Meridiany nauki").

A19. **The Institute of Space Research** of the USSR Academy of Sciences nominated Academician G. I. Petrov as a candidate for deputy to the Moscow City Council. Academician Petrov is well-known in the fields of theoretical and applied mechanics and computer technology (February 11, p. 1, "Po vole naroda").

A20. **The Angara Petroleum-Chemical Combine** is planning to put a new computer center into operation by April 1970. More than 500 qualified persons will be freed for other work when this center opens (February 11, p. 1, "Estafetu sorevnovaniya prinyali neftekhimiki").

A21. **The Severodonetsk Chemical Combine** is planning in 1969 to automate technological processes and the system of management, planning, accounting, and processing of production data by introducing computers (February 12, p. 1, "Trudovoj vklad khimikov").

A22. **A new computer center** has been put into operation in the Khirghiz SSR (February 13, p. 1, "Vychislitel'nyj tsentr"). [See Brief Item, **SC:RNI,** this issue.]

A23. **The Tatneft' Petroleum Association** is planning to automate production processes and introduce scientific organization of labor in 1969. This will result in a savings of eight million rubles and free more than 1000 workers for other tasks (February 13, p. 1, "Shirokaya postup' sorevnovaniya").

A24. **Academician V. M. Glushkov** comments on the work of the Ukrainian Academy of Sciences on the occasion of the Academy's 50th anniversary (February 13, p. 2, "Polveka poiskov i otkrytij"). [See **SC:RNI,** this issue, "The Fiftieth Anniversary of the

Ukrainian Academy of Sciences."]

A25. **Human speech and computers** was one of the subjects discussed by L. A. Chistovich at the 13th session of the Joint Scientific Council on Physiology of Man and Animals of the USSR Academy of Sciences. Chistovich stressed the necessity of investigating human speech and using the results to perfect talking machines. Such machines should not only perceive 20-30 voice commands, but also understand speech and be able to reply; they must be able to conduct a conversation with their creators. Two types of talking machines are now being developed. The first type will be a completely "taught" and formulated system, capable of using several languages. The second type will be "teachable" and capable of being altered and improved. To create such models, scientists are studying how an infant learns to speak and understand, and they are investigating the role of adult influence. New methods being used to study human speech include: 1) introducing a fine light probe into the larynx, so that the light reflected from the moving vocal cords is transmitted along the optical fibers of the probe onto a screen which is observed by scientists; 2) automatic X-ray tracing (using a computer) of a moving spot on the surface of the tongue, soft palate, etc., in order to study the movements of the tongue, lips, and lower jaw, the stress of the vocal cords, etc. (February 15, p. 5, "Poznaj sebya").

A26. **The Dzerzhinskij Ural Wagon-Building Plant** is adopting an automated production control system which uses computers and other devices to collect and process initial information (February 16, p. 1, "Tempy, kachestvo").

A27. **A. I. Kostousov,** Minister of the Machine and Instrument-Construction Industry, stated at a recent meeting that this year, as in the past, attention will be given to perfecting precision instruments and developing special- purpose equipment, automated lines, and machines with programmed control. The number of enterprises which specialize in producing one type of product will be sharply increased (February 18, p. 3, "Vysokoe kachestvo, progressivnaya tekhnika").

A28. **Aleksandr Adreevich Samarskij,** Corresponding Member of the USSR Academy of Sciences, was awarded the Order of the Red Banner of Labor for his work on the development of computational mathematics and mathematical physics (February 20, p. 2, "Nagrada uchenomu").

A29. **A research ship** of the USSR Academy of Sciences, the **Vityaz',** recently returned from a voyage in the southern part of the Pacific Ocean. The data it obtained will serve for the construction of a mathematical model of the biological production of the ocean and will help to further research in this area (February 20, p. 5, "Korabl' vozvrashchaetsya").

A30. **Glass-like films** made of alloys of crystal materials have properties which make them extremely useful in electronics. Glass-like films can be used for semiconductors and can be made smaller and faster than those now used in computers. Leningrad scientists and specialists of the German Democratic Republic, Rumania, and Czechoslovakia are conducting further research on glass-like semiconductors, and this is attracting the attention of other physicists and engineers. The valuable properties of these materials, their simplicity, and their low cost can pave the way to new semiconductor devices (February 25, p. 4, "Steklo i elektrichestvo").

A31. **A new automatic data processing system** has been introduced at the Strojbank (All-Union Bank for the Financing of Capital Investments). The system was developed under the direction of E. N. Kopach, Candidate of Physicomathematical Sciences and Head of the Computer Center of the Siberian Scientific Research Institute of Power Engineering. A BESM-4 computer, which can operate 22 hours a day, is being used in the new system. In addition to helping their own laboratories, the Computer Center also gives advice and conducts engineering calculations for 27 "outside" organizations of Novosibirsk (February 27, p. 2, "Bank i elektronika").

A32. **The Transport Administration of Civil Aviation** reports that its 1969 plan includes widescale mechanization and automation of passenger services and mail and freight delivery; mastering and introduction of automated systems of landing; and the establishment of a new computer center at the Vnukovo Airport (February 29, p. 1, "Slovo aviatorov stolitsy").

KRASNAYA ZVEZDA—ARTICLES

A33. **Electronic and cybernetic equipment** is introduced into military activities only by commanders who have first succeeded in raising their own level of knowledge of modern military science (February 1, p. 2, "Eruditsiya komandira").

A34. **The President of Southern Yemen,** Qahtan al-Shaabi, and other Yemeni officials visited the Academy of Sciences of the Azerbaijan SSR (February 8, p. 1, "Prezident NRYuJ v Baku").

A35. **Teaching machines** are not used to train artillery men in some military districts. This is a mistake, for very complex aerial situations can be modeled on teaching machines (February 8, p. 2, "Ispytanie boem").

A36. **The production of computers** and electronic and automatic equipment in the USSR increased 16 per cent in 1968, according to **Business Week**, as quoted by **Krasnaya zvezda** (February 9, p. 1, "'Biznes uik': sovetskie tempy vyshe").

A37. **Computing equipment** and mechanized hardware must be mastered more quickly to lighten the work of headquarters officers. Commanders and headquarters chiefs who are beginning to use network methods of planning are on the right track (February 11, p. 1, "Shtab na ucheniyakh").

A38. **Programmed teaching machines** are used to train radar operators. Officer N. Korolev has equipped his technical tactical class with them. An entire complex of training devices and teaching machines has been built, and indicator panels are being used to model aerial situations (February 12, p. 1, "Antenny smotryat v nebo").

A39. **A. D. Noskov** is the Chief Engineer of the All-Union Scientific Research Institute of Medical Instrument Construction (February 15, p. 1, "Registratsiya kandidatov v deputaty").

A40. **An artillery battalion** commanded by Lt. Col. P. S. Yasnov is discussed by Lt. Cols. N. Mel'nikov and I. Anisin. Every fifth man in the battalion is a Communist; 73.6 per cent of the battalion has higher, secondary technical, or secondary education. Half the battalion works with some kind of technology. Sr. Lt. Boris Shorenko — an electronic computer specialist — has made a small instrument which speeds up the process of measuring the parameters of an electronic computer. Today's artillery men must know electronics, physics, precise mechanics, mathematics, etc. (February 15, p. 3, "Lyudi raketnoj zastavy").

A41. **Academician G. Petrov**, Director of the Institute of Space Research of the USSR Academy of Sciences has been registered as a nominee to the Moscow City Council (February 18, p. 1, "Narodnye kandidaty").

A42. **Bulgarian newspapers** publish news every day on the creation of new machines, machine tools, and electronic instruments in scientific institutes and in enterprises (February 19, p. 3, "Korotko iz raznykh stran").

A43. **Automation and radioelectronics** are the basis for some of the equipment an artillery man must deal with. Teaching machines play a large role in the training of soldiers. These machines raise the possibilities of the teaching process and economize on the resources of combat technology. Some of these machines are designed by military inventors (February 20, p. 1, "V interesakh boevoj vyuchki raketchikov").

A44. **Computing equipment, cybernetic devices,** radioelectronics, remote control, and complex automation and mechanization are being more widely applied in the armed forces, according to N. I. Krylov, USSR Deputy Minister of Defense, Chief Commander of the Strategic Artillery Forces (February 20, p. 2, "Vsemerno ukreplyat' edinonachalie").

A45. **I. I. Yakubovskij**, Marshall of the Soviet Union, states that cybernetics, electronics, automation, and other achievements of science and technology are being introduced in the army and the navy at a very rapid pace (February 23, p. 2, "Missiya vysokaya, istoricheskaya").

A46. **Biotelemetric equipment** designed at Kaunas Medical Institute is being used by a sanitorium in Palanga, Lithuania, to maintain direct radio communication between a patient and a scientific laboratory. Contact continues even when the patient is strolling about or performing gymnastic exercises (February 26, p. 4, "Lyubitelyam neobychnogo").

EKONOMICHESKAYA GAZETA—ARTICLES

A47. **Laureates of State Prizes** of the USSR for 1968 were presented awards on January 28 by President of the USSR Academy of Sciences, M. V. Keldysh. A State Prize was bestowed on a group of economists for developing methods of analyzing and planning intersectorial relations and the sectorial structure of the national economy and for constructing planning and accounting intersectorial balances. Diplomas and medals for this research were awarded to A. N. Efimov, E. B. Ershov, F. N. Klotsvog, S. S. Shatalin, E. F. Baranov, L. E. Mints, V. V. Kossov, L. Ya. Berri, and M. R. Ejdel'man (No. 6, February, p. 3, "Vysokaya nagrada").

A48. **The Likhachev Automobile Plant** in Moscow has decided to create four comprehensively mechanized shops and to introduce new automatic and mechanized lines, an automated dynamic production management system, and new technological processes (No. 6, February, p. 3, "Tekhnicheskomu progressu vysokie tempy").

A49. **An international symposium** on "Invention and Scientific and Technical Progress and Problems of Patent and Information Search," which opens July 1 in Moscow with some 1500 attendees, will be among events marking the 50th anniversary of Soviet invention. Specialists on computers, mathematical linguistics, programming, and mechanized and automated information retrieval, as well as workers from patent and information services, will present 20-25 papers devoted to the theory and practice of information retrieval, certification, and determination of the level of scientific and technical development (No. 6, Febru-

ary, p. 6, "Izobretatel'stvo i patentnyj poisk").

A50. **Professor A. Ya. Boyarskij,** Doctor of Economic Sciences and Director of the Scientific Research Institute of the USSR Central Statistical Administration, surveys the research undertaken by the Institute last year and projects planned for this year. Of particular interest is the Institute's past and future work in establishing a state network of computer centers (No. 6, February, p. 15, "Nauchno- issledovatel'skij institut TsSU SSSR"). [See **SC:RNI,** this issue, "State Network of Computer Centers: Development Progress Report."]

A51. The application of computers and mathematical economics to the analysis of national economic processes is called for by Candidate of Economic Sciences L. Chernysh. In particular, he emphasizes the importance of such techniques in studying and predicting consumer demand (No. 6, February, p. 20, "EVM v planirovanii").

A52. **The "Nauka" Store** (of the Main Administration of Material and Technical Supply under the Council of Ministers of the Belorussian SSR) and the "Pribory" Store (of the USSR Ministry of Instrument Construction, Means of Automation, and Control Systems) are located in the same building in Minsk, sell the same kind of equipment (measuring and optical- mechanical devices, weights, etc.), and serve the same consumers. The author points out how this situation results in extreme confusion and waste and proposes that the two stores be consolidated under the Belorussian Main Administration. Moreover, this situation is not unique; the Ministry of Instrument Construction, Means of Automation, and Control Systems has opened its own stores in other cities. The author thinks this is improper, believing it necessary to build a single supply system (No. 6, February, p. 21, "Luchshe odin, da khoroshij").

A53. **A. Smolkin,** Deputy Head of the Scientific-Methodological Section of the All-Union Scientific-Methodological Center on the Organization of Labor and Production Control, State Committee on Problems of Labor and Wages, suggests that enterprises introducing automated systems or organizing computer centers conduct a special school for all workers connected with the preparation and transmission of data and with the introduction and operation of computer hardware (No. 6, February, p. 22, "NOT - delo kazhdogo").

A54. **Several foreign machines** have been exhibited recently in Moscow. They include the Chenumat turret lathe with ERS 200 program control (Hungary) and the UWQ 40 X 400 transverse rolling machine (East Germany) (No. 6, February, pp. 34-35, "Simvol progressa - tochnost'"). [See P6.]

A55. **The USSR Ministry of the Food Industry** has adopted a resolution to organize an All-Union Scientific-Production Association, "Pishchepromavtomatika," in Odessa. It has been charged with a complex of projects, including conducting scientific research; designing, constructing, installing, and debugging automated enterprises and technological complexes; teaching operational personnel; and exercising technical supervision of operational personnel (No. 6, February, p. 36, "Khronika").

A56. **Academician G. Boreskov,** State Prize laureate and Hero of Socialist Labor, writes on the future of catalysis. He envisions the growing and reproducing of the most complex equipment - including computers according to given programs. He is convinced that science, sooner or later, will outdo nature, reproducing diverse hardware more complex than the living organisms which serve as its prototype (No. 6, February, p. 37, "Sorevnuyas' s fantastami").

A57. **Chairman G. Kozel'** states that the Standing CEMA Commission on Construction, along with specialists from other standing commissions, is developing methods of increasing the efficiency of capital construction through the selection of optimum solutions. Network planning, computer hardware, and modern methods for handling scientific and technical information are being employed. D. Khorgosh, Chairman of the Standing CEMA Commission on the Radioelectronic and Electronic Industry, notes that in 1966 the commission prepared recommendations calling for fulfillment of member countries' demand for various forms of computer hardware (medium-size, general-purpose digital computers, magnetic drum memory units, perforators, and general-purpose analog computers) and radioelectronic equipment. At the present time, work is being done in many areas, including the creation of a single system for information processing and data transmission as well as hardware for these purposes (No. 6, February, pp. 42-44, "SEV - sodruzhestvo ravnykh").

A58. **The mechanized accounting station** of the Orgtekhstroy Trust in Novosibirsk advertises for sale an Optimum-2 analog computer intended for the solution of transport problems (No. 6, February, p. 46 I, "Prodadim elektronnuyu analogovuyu mashinu").

A59. **A Ural-2 computer** is advertised for sale by a certain organization in Moscow identified only by its address and telephone number (No. 6, February, p. 46 I, "Prodadim").

A60. **The Termoplast Plant** in Minsk wishes to buy thermoplastic automata (No. 6, February, p. 47 I, "Termoplastavtomaty").

A61. **The Sil'va Hosiery Factory** in Kaunas advertises the sale of 194 KAS-22 hosiery automata (No. 6, February, p. 47/1, "Prodadim 194 kruglochulochnykh avtomata KAS-22").

A62. **The Kuibyshev Diesel Locomotive-Building Plant** in Kolomna, originally built in 1863, is being modernized. Its computer center has modernized the two Ural-2 computers it had and added a Ural-4. In addition, the center put a Minsk-22 into operation late last year. The computers are used for a variety of jobs, but about 70% involve engineering and design calculations. Using computers for these calculations alone saves the plant 180,000 rubles per year. An automated production control system is now being readied for introduction at the plant (No. 7, February, p. 14, "Molodeet staryj zavod"). [See P7.]

A63. **The Chelyabinsk Tractor Plant** intends to increase the number of automatic and semiautomatic machine tools to 60% of the total number in operation. It also plans to expand its computer center and equip it with modern hardware and a centralized system for dynamic telegraph communication with the enterprises that supply parts for the T-130 tractor (No. 7, February, p. 14, "Rekonstruktsiya s borodoj").

A64. **Academician N. P. Fedorenko,** Director of the Central Economic-Mathematics Institute of the USSR Academy of Sciences, reports the results of the Institute's research in the past year and its plans for 1969 (No. 7, February, p. 15, "Tsentral'nyj ekonomiko-matematicheskij institut"). [To be translated in **SC:RNI/69/4.**]

A65. **Tsvetmetavtomatika Special Design Bureau,** headed by L. Kazanskij, works on the automation of technological processes involved in the mining and concentration of ore and in the production and processing of nonferrous metals. The Bureau has a reputation for following through on its projects, from the inception of an idea to the actual installation and debugging of equipment. Its organization (which consists of research, design, and experimental production branches) and operation are compared by the author with that of a scientific- production association (No. 7, February, p. 16, "SKB ili firma?").

A66. **The Minsk-32 computer** is one of the most popular exhibits at the Belorussian Exhibition of National Economic Achievements, a permanent exposition in Minsk (No. 7, February, p. 18, "Belorusskaya VDNKh").

A67. **Economist E. Chomaryan** develops several criteria to be considered when studying the economic advantage of introducing a control computer (No. 7, February, p. 21, "Kogda EVM vygodny?"). [To be translated in **SC:RNI/69/4.**]

A68. **"Electronics for Plants,"** an article by A. Saturenskij, head of the Information-Computer Center of the Ordzhonikidze Plant in Minsk, appeared in the republic newspaper **Sovetskaya Belorussiya.** The author believes the most important way of increasing the efficiency of production is to perfect management of the industrial enterprise. The role computer technology can play in this area is stressed. The author treats a number of problems connected with the introduction of computer hardware and emphasizes that it is necessary to design comprehensive automated control systems (No. 7, February, p. 36, "'Elektroniku —na zavody'").

A69. **According to A. Dimitrov,** Chairman of the Standing CEMA Commission on the Food Industry, the commission is now studying the experience of member countries in the application of mathematical methods and computer techniques to the planning and control of production in the food industry. D. Gvishiani is Chairman of the CEMA Standing Commission on the Coordination of Scientific and Technical Research, which organized a symposium on "The Management, Planning, and Organization of Scientific and Technical Research" in Moscow, May 1968, for member countries of CEMA and Yugoslavia (No. 7, February, pp. 42-43, 'SEV—sodruzhestvo ravnykh").

A70. **Moscow Economic Statistics Institute** of the USSR Ministry of Higher and Secondary Specialized Education announces several vacant positions in its branch scientific research laboratory on the theory of mechanized economic data processing and its problem laboratory on software for automated control systems (No. 7, February, p. 47/1, "Moskovskij ekonomiko-statisticheskij institut Ministerstva vysshego i srednego spetsial'nogo obrazovaniya SSSR").

A71. **The Ivanovo Computer Center** of the Ministry of Light Industry has taken the first step in using computers to set wholesale prices. Experimental calculations of a price list for unbleached cotton as well as unbleached and finished wool fabrics were performed here. The experiment demonstrated that the computer can take on the most important and labor-consuming steps in setting prices. The direct calculation of new prices for cotton fabric and of results of introducing them at enterprises took 25 minutes (No. 7, February, insert, p. 3, "Vpervye v praktike").

A72. **The All-Union Conference** of Price Formation Workers (held in Moscow, February 4-6) pointed to the necessity of developing promising computer-based methods of setting prices. Computer techniques are only now beginning to be used in the practice of price formation. The first experience of compiling

price lists using computers was described in a brochure published by the Scientific Research Institute of Price Formation (No. 7, February, insert, pp. 7 8, "Opyt, problemy, predlozheniya").

A73. **A 118 per cent increase** in the volume of production (compared to January 1968) was reported in January by the Ministry of Instrument Construction, Means of Automation, and Control Systems. Instruments and automation and computer hardware worth 190 million rubles were produced in January 1969 (No. 8, February, p. 3, "Promyshlennost' SSSR v yanvare 1969 goda").

A74. **The Privolzhskij Region Administration** of Material and Technical Supply is rationalizing its management and operation. New calculations devised for planning deliveries and monitoring their completion may be executed either by punchcard equipment or computer. This year, the Administration's own computer center will begin operation (No. 8, February, p. 17, "Privolzhskij variant").

A75. **The AID-6 device** for automatic control of the diameters of parts in machine tooling was designed at the Krasnoyarsk Agricultural Institute. Its components include an electronic control unit employing semiconductors and dekatrons (No. 8, February, p. 35, "Avtomat vmesto mikrometra").

A76. **Scientific and technical progress** in Leningrad is reported. Some 450 enterprises, shops, and sections have been mechanized and automated, and 470 mechanized lines and conveyors have been introduced in Leningrad during the current five-year plan. In addition, 110 computer centers equipped with computer hardware have been established and are in operation in the city's enterprises and organizations. More than 30 of them are now solving problems of planning, accounting, and production control. Leningrad's severe labor shortage makes the specialization of industry and the most rational use of labor resources very important. The author censures the Ministry of Instrument Construction, Means of Automation, and Control Systems (the most widely represented in Leningrad, having 30 enterprises there) for having done almost nothing in the specialization and concentration of Leningrad enterprises (No. 9, February, p. 6, "Bol'she, luchshe, deshevle!").

A77. **Two Ruta computer systems** will be acquired and programmers and mechanics will be trained in computer operations by the Sterlitamak Synthetic Rubber Plant as part of its measures to achieve scientific organization of labor (No. 9, February, p. 7, "Vzaimosvyas'").

A78. **The Scientific Research Economics Institute's** research during the past year and its plans for research during 1969 are sketched by its director, A. N. Efimov, Corresponding Member of the USSR Academy of Sciences. The Institute is subordinated to the USSR Gosplan (No. 9, February, p. 16, "Nauchno-issledovatel'skij ekonomicheskij institut pri Gosplane SSSR").

A79. **V. D'yachenko,** Candidate of Economic Sciences, reviews the book, **System of Economic Sciences (Sistema ekonomicheskikh nauk),** a collection of essays published by "Nauka" Publishing House in 1968. The book surveys methodological problems involved in the classification of economic science. A special chapter of the book is devoted to the question of the role of mathematical methods in economic science, which is also touched on by other authors throughout the collection. According to D'yachenko, the general attitude expressed by these authors is that when using mathematics and computer techniques it is necessary to proceed from the methodological principles and laws of the political economy of socialism. The reviewer believes, however, that mathematical and cybernetic approaches must organically permeate the entire system of economic sciences. As a whole, the reviewer finds the book useful and timely, but he criticizes its failure to treat the field of sociology (No. 9, February, p. 36, "O problemakh metodologii i klassifikatsii").

A80. **An Amur automatic machine** for the automatic centralized monitoring and regulation of temperature in enterprises of various kinds (including chemical and food) is advertised for sale by "Moldvinshampankombinat" in Kishinev (No. 9, February, p. 47/1, "Moldvinshampankombinat").

NEDELYA—ARTICLES

A81. **Leningrad State University** has graduated about 80,000 highly qualified specialists since the October Revolution in 1917, including 256 academicians and corresponding members of the USSR Academy of Sciences. Student enrollment is now 20,000; this includes 1500 postgraduate students and trainees and 800 foreign students, postgraduate students, and trainees. Among the 2000 professors and instructors, there are 30 academicians and corresponding members of the USSR Academy of Sciences and republic and branch academies; 257 professors and doctors of sciences; and 798 candidates of sciences. There are eight scientific research institutes and a computer center; 800 scientific associates work in these and other affiliated institutions (February 9, pp. 10-11, "Sodruzhestvo umov").

A82. **Representatives of North Korea's** Central Statistical Administration, which is interested in the

collection and processing of statistical information and in the organization of analytical and experimental work, visited a computer center in Rezekne, Latvia, recently. The delegation plans to spend about a year in Belorussia in order to study hydroelectric systems. The leader of the delegation is Kim Khab Bon, Chief of North Korea's Computing Operations Administration (February 23, p. 2, "Gosti nashej strany").

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A83. **Academician Ivan Artobolevskij** discusses the significance of space research to progress in many modern spheres of knowledge and practical activity. He states that a problem of high priority is the study of the automatic control of all on-board systems. "If we succeed in achieving such control in space, we shall obviously be able to introduce it on earth. In mines, for example, automatically controlled machines could free men from underground jobs. Therefore, the problem of automatic control in space is a general technical problem with which we shall have to deal on earth." Artobolevskij further states that "when man lands on other planets, it must be possible for him to move and carry out certain operations. This means we must design the appropriate mechanisms. At present, a so-called theory of manipulators is being developed on an increasing scale. Manipulators are now used on automatic production lines to transfer parts from one position to another. A mechanical hand able to reproduce all the movements of a human hand could do very heavy work in space, with comparatively little effort needed on the part of the cosmonaut. This research is closely related to biology, since such mechanisms will be operated by human biocurrents. Naturally, much of this will find practical application on earth, for instance, in mining, in studying the ocean depths, and in many other cases when man himself will simply be unable to do certain jobs" (No. 4, February 1-8, p. 3, "For Human Progress").

A84. **M. Nesterov,** President of the USSR Chamber of Commerce, states that the Automation-69 Exhibit will have four basic sections: 1) sensitive elements in instruments for control and regulation, electromechanical and noncontact relays, electronic elements, and components, parts, and complete sets of equipment; 2) modern means of automation: both electronic and pneumatic, including digital, analog, and hybrid computers; 3) modern means of automation in management systems in various branches of industry and servicing; 4) advanced technological processes and modern instrument-construction equipment. The Soviet section of the exhibit will cover an area close to 11,000 square meters. According to preliminary estimates, it will contain about 1500 displays (No. 4, February 1-8, p. 15, "International Exhibitions in Moscow").

A85. **Moscow University** is now one of the largest establishments of higher learning in the Soviet Union. Every day, 33,000 students and postgraduates come to its lecture rooms. Eighty academicians and corresponding members of the USSR Academy of Sciences, and several hundred professors help give them a higher education (No. 6, February 15-22, p. 6, "Our Studies in the Soviet Union").

A86. **The All-Union Geophysics Research Institute** has evolved a new method of geological prospecting by using the seismic waves created by earthquakes. The instruments used in the new method were made at the experimental plant of the USSR Academy of Sciences' Siberian Department. This method has a number of advantages over traditional ones. First, there is no need for drilling or blasting—the earth itself provides the seismic waves. They have only to be amplified and taped, then a seismogram can be made with the help of reproducing devices. Secondly, these waves penetrate to a depth of 10 km. And finally, this method enables a simultaneous study to be made of the interior of a huge area of the earth (No. 6, February 15-22, p. 14, "Earthquakes Probe the Earth").

A87. **Professor Victor Bugayev,** member of the Uzbek Academy of Sciences and director of the World Meteorological Center in Moscow, states that the center collects, processes, and distributes hydrometeorological information, conducts wide-ranging research on the circulatory process in the atmosphere, and evolves hydrometeorological forecasting methods. The center has a computer room where data is received via numerous communication channels, processed, and prepared (No. 7, February 22-March 1, p. 11, "The Weather Forecasters"). [See P10.]

A88. **Scientific forecasting,** computers, microminiaturization, etc., are discussed by V. Siforov, Corresponding Member of the USSR Academy of Sciences. He believes that in the comparatively near future, "a global system of machines, a single automated system of communication, and a single system of scientific, technical, and other data," all of which will be correlated, will be developed (No. 7, February 22-March 1, p. 14, "Science of the Future").

A89. **The All-Union Academy of Agricultural Sciences** recently held a meeting in Moscow. It was resolved that in the field of mechanization of agriculture, the scientists should direct their efforts primarily toward the creation of improved engineer-

ing means and machine systems so that production can be put on an industrial basis. The most urgent tasks of all are the setting up of electromechanized farms and the evolvement of systems of electrical machines and automatic conveyor lines for the preparation of fodder, milking of cows, initial processing of milk, collection and processing of eggs, etc. (No. 7, February 22-March 1, p. 14, "Science and Agricultural Production").

PRAVDA—PHOTOGRAPHS

P1. **At the Mylishchinskij Instrument-Building Plant,** workers are assembling complex devices (February 4, p. 1).

P2. **The Computing and Information Center** of the "Frezer" Plant in Moscow (February 25, p. 1). [Reproduced, **SC:RNI,** this issue, "The Frezer Plant's Computer Center."]

P3. **The control panel** of the powerful gamma installations at the Chair of Scientific Research of the L. Ya. Karpov Physicochemical Institute (February 28, p. 3).

IZVESTIYA—PHOTOGRAPHS

P4. **An automatic ticket printing machine** installed at the stations of the Leningrad October Railroad (February 27, p. 1).

EKON. GAZETA—PHOTOGRAPHS

P5. **The UM-1 computer** is among the modern equipment allowing dynamic monitoring of production processes at the "Lutuginskaya Severnaya" coal mine of the Lenin Coal Trust (Lugansk Oblast') (No. 6, February, p. 4, "Dlya shakhterov"). [Reproduced, **SC:RNI,** this issue, "The UM-1 Control Computer."]

P6. **A Chenumat turret lathe** with ERS 200 program control and UWQ 40 X 400 transverse rolling machine (No. 6, February, pp. 34-35, "Simvol progressa--tochnost'"). [See A54.]

P7. **The Minsk-22** in the computer center of the V. V. Kujbyshev Diesel Locomotive-Building Plant in Kolomna, along with three of the plant's personnel (No. 7, February, p. 14, "Molodeet staryj zavod"). [See A62.]

P8. **Grigorij Andreevich Grishukov,** one of the builders of the Vilnius Calculating Machines Plant, who has worked there for 17 years. He is now brigade foreman of lathe operators (No. 7, February, p. 16).

NEDELYA—PHOTOGRAPHS

P9. **The Computer Center** of Leningrad State University (February 9, p. 11). [See Brief Item, **SC:RNI,** this issue.]

MOSCOW NEWS—PHOTOGRAPHS

P10. **The computer room** of the World Meteorological Center in Moscow, showing an M-20 computer (No. 7, February 22-March 1, p. 11). [See A87.]

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10. ABSTRACT

This issue features an article on small computers and a progress report on the State Network of Computing Centers. Two articles, one popular and one technical, describe the planned Sirena-1 system for airline reservations. The system differs from Western systems in two respects: (1) It does not apply to all of Aeroflot's ticket sales and reservations, but only to the Moscow airport, with some tie-ins to other major airports for return flights to Moscow. (2) It provides automated printing for individual passenger tickets. A description of the computer science curricular and support activities of Moscow State University is provided by an article on the University Computer Center. Other items of interest include (1) a biography of Academician, Engineer-Admiral Aksels I. Berg, on the occasion of his 75th birthday; (2) a critique on how scientists spend their working hours; (3) an article on the Lvov Information Control System (designed by Glushkov for the Lvov TV Factory), which the Ukranian Academy of Sciences has ordered to be generalized for use in a wide range of factories engaged in mass production of a limited variety of products.

11. KEY WORDS

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